Community Assistantship Program

Inventory and Assessment of Natural Resources in Crow Wing County: A Framework for Conservation and Recreation Planning

Inventory and Assessment of Natural Resources in Crow Wing County: A Framework for Conservation and Recreation Planning

Prepared in partnership with
Brainerd Lakes Area Conservation Collaborative

Prepared by
James Lehnhoff
Graduate Student

University of Minnesota
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Center for Urban and Regional Affairs (CURA)
University of Minnesota
330 HHH Center
301--19th Avenue South
Minneapolis, Minnesota 55455

Phone: (612) 625-1551
Fax: (612) 626-0273
E-mail: cura@umn.edu
Web site: http://www.cura.umn.edu

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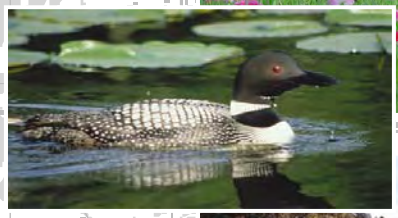
A Framework for Conservation and Recreation Planning



Brainerd Lakes Area Conservation Collaborative

Created by James Lehnhoff

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INTRODUCTION

Few would argue that protecting the natural environment is an undeserving endeavor. The Brainerd Lakes Area of Minnesota is blessed with an abundance of lakes, wetlands, forests, beautiful scenery, and open space. Although expanding residential, commercial, industrial, and road development are an integral part of the Brainerd regional economy, new development is straining the natural environment—the very reason many people move to the Brainerd area is being threatened. However, new development attracts money and jobs to the area. While allowing continued development and protecting the natural environment may seem contradictory to some, these two goals are not mutually exclusive. Certain areas have greater natural value or significance worthy conservation, while other areas are more suitable for development.

In early 2003, twelve organizations, representing government and non-profit sectors, formed the Brainerd Lakes Area Conservation Collaborative (BLACC) with support from Bremer Bank. Due to limited resources, the member organizations combined portions of their missions and resources to identify mutually beneficial conservation areas that will make the most of limited conservation funds[1]. Based on the mission of each member, the collaborative identified a set of priority natural features and attributes to identify areas in need of protection. In addition to identifying ecologically significant features, BLACC identified existing recreational resources and areas important for groundwater protection into its mission, both of which contribute to healthy quality of life for humans as well as the natural environment.

While BLACCs key mission is to protect and conserve the ecologically significant terrestrial and aquatic habitats in the Brainerd area, the collaborative acknowledges that Crow Wing County and the surrounding counties are growing and new development is a part of the region's future. The collaborative recognizes the rights of property owners and is not suggesting that development should be stopped everywhere. Instead, BLACCs primary aim is to assist residents, businesses, developers, institutions, and governmental organizations in guiding development away from some ecologically significant areas, suggesting environmentally sensitive development in other ecologically significant areas, and locating most growth in locations most suitable for development. On the same note, the collaborative seeks to identify new recreational opportunities that are compatible with the surrounding environment and are accessible to the region's population. Finally, BLACC seeks to identify and protect groundwater resources to maintain and enhance the quality of life for existing and new residents. The Brainerd lakes region is one of the fastest growing regions in Minnesota, and it is important to guide development now to preserve natural and recreational systems and encourage economic development by protecting the qualities that bring people to this part of Minnesota.

This report is a toolbox of data designed to assist stakeholders in making decisions regarding the future of natural resources, conservation, and recreation in the Brainerd region. In order to help

[1] 1000 Friends of Minnesota, The Nature Conservancy, Crow Wing County Parks Department, Crow Wing County Planning Department, the Initiative Foundation, the Minnesota Land Trust, the Trust for Public Land, the Minnesota Lakes Association, the Minnesota Department of Natural Resources, the Minnesota Pollution Control Agency and the Board of Water and Soil Resources, Crow Wing County Soil and Water Conservation District, and Bremer Bank for project support

make informed choices, the ecologically significant areas, potential recreational resources, and groundwater contamination susceptibility areas need to be inventoried and assessed. This report identifies and assesses potentially ecologically significant terrestrial and aquatic habitats, new recreational opportunities, and areas more or less suitable for development in the Crow Wing County area. These identified features are then used to help recommend where recreation could be expanded and where new development should recognize and adjust their design to be compatible with and protect the unique or ecologically significant features.

This report is presented in three analysis sections:

1. Healthy Natural Communities analysis
2. Healthy Human Communities analysis
3. Development Suitability analysis

The Healthy Natural Communities analysis assesses the region's significant natural resources based on biodiversity, unique natural features, high value aquatic environments, and high value terrestrial environments. Data to either directly identify or to indicate where important natural features exist were mapped and merged to determine where major natural resources overlap. Overlapping features provide opportunities for BLACC members to conserve multiple natural resources in one location—essentially, getting the most "bang for the conservation buck."

The Healthy Human Communities analysis focuses on what makes the study area livable for the increasing population in the Brainerd area. While a number of attributes contribute to the quality of life in a given location, this report focuses on recreational opportunities, open space resources, and areas important for groundwater protection to protect the local drinking water supply. These particular quality of life attributes are directly related to the Healthy Environment Communities analysis because open space and groundwater supplies rely on healthy natural areas for protection, and recreational activities directly affect the health of many natural environments. In addition, these assets – once lost or impaired – would be costly or impossible to replace or mitigate.

The Healthy Human Communities and the Healthy Natural Communities analyses also address the stresses that human and natural communities are facing, locate potential expansion opportunities for conservation or recreation, and describe the methodology used to identify natural and recreational resources.

The final section of this report combines the data from the Healthy Human Communities section and the Healthy Natural Communities section to create a composite map as part of a Development Suitability analysis. The data and results from the Healthy Natural Communities and the Healthy Human Communities analyses are used to provide broad recommendations for development suitability in the study area. While this report provides general recommendations, it is out of this report's scope to prescribe specific strategies and locations for development or conservation—this report is meant to assist decision makers make informed or prudent choices on the management of the ecological and recreational opportunities in the study region. Most final decisions will rely on the wisdom of local units of government, private property owners, input from residents, and other stakeholders.

While the primary goal of this report is to identify ecologically significant and recreational opportunities in the Brainerd Area, it is hoped that the ideas and methodologies developed for analysis will be replicated elsewhere. To further that goal, the methodology is described in simple terms in the report and most of the data are available at no cost online or through local, county, and state agencies. While available electronic information seems to expand at breathtaking speeds, gaps and errors persist in most data. Known weaknesses in the GIS data and methodology will be addressed where appropriate. A full list of data sources is available in the bibliography.

There are two main limitations to keep in mind as this report is read and used for planning purposes. The maps are not intended for parcel-specific analysis and should not be used for that purpose. Instead, this report is intended to guide choices for development and environmental conservation on a larger scale, such as where subdivisions or other large developments will have the least adverse impact to natural systems and where conservation resources can be used more efficiently. Secondly, while maps often use distinct lines to divide land uses or ecosystems, neither natural nor human systems always end at a specific boundary. At times, limited data availability forces discrete lines where discreet lines do not exist. Natural changes are usually gradients of change. Therefore, it is important to remember that lines on maps in this analysis (or any other map for that matter) are approximations rather than absolutes. Lake levels change, wetlands shrink and swell, and ecosystems can gradually change across an area.

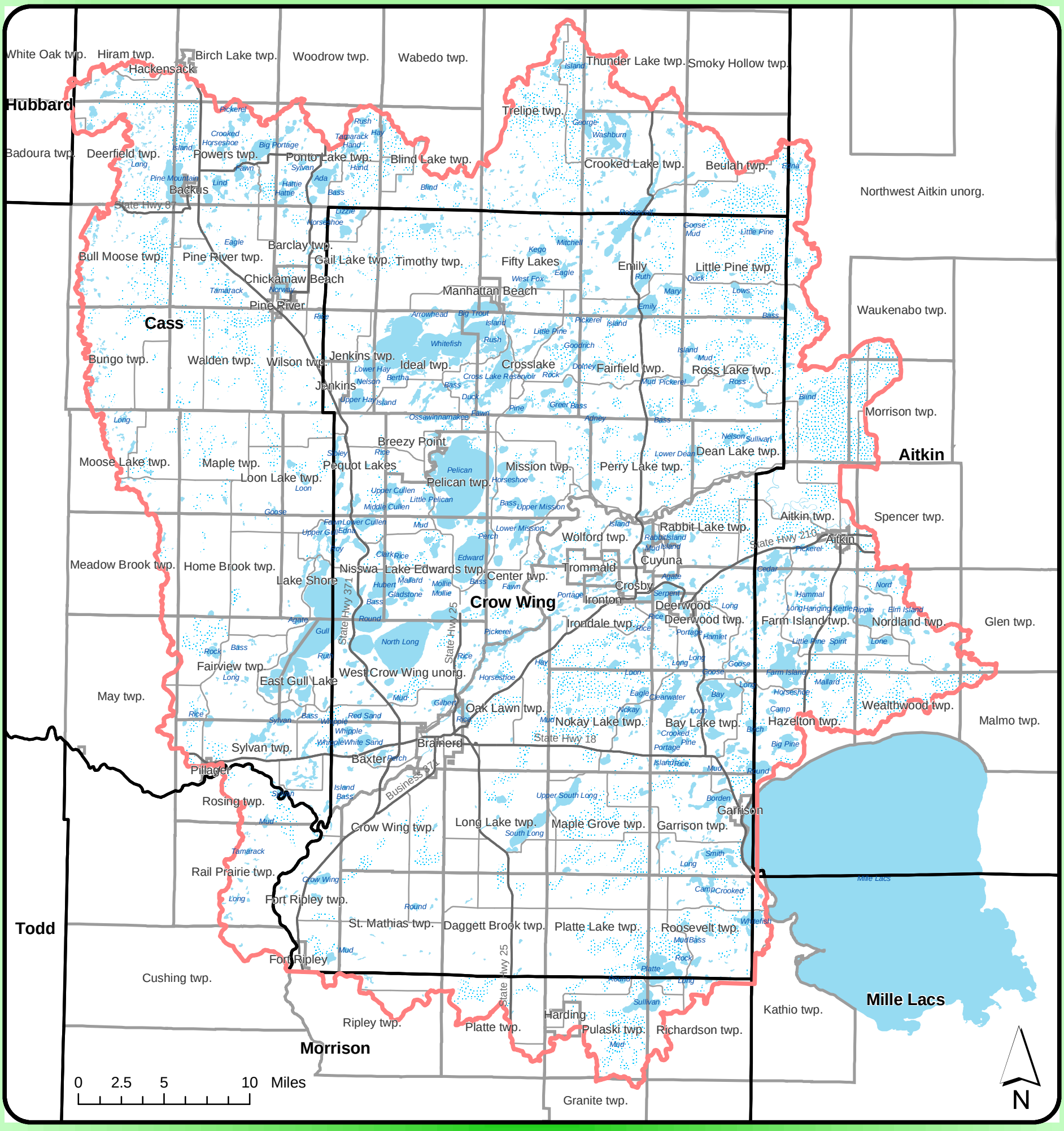
The Study Region

Although this study focuses primarily on Crow Wing County for planning purposes, the study region includes land and water outside of Crow Wing County. As just stated above, natural systems, particularly aquatic habitats, do not begin or end at human-defined political boundaries. Because upstream watersheds affect downstream watersheds, it was not possible to restrict the study to within the Crow Wing County borders. While human boundaries can be adjusted (at least in theory), it is more difficult to force ecosystems into a specified boundary. Therefore, the BLACC identified a series of watersheds that includes all of Crow Wing County and extends into portions of Cass, Morrison, Aitkin, and Hubbard counties (Map 1). The study region encompasses or touches 105 municipalities across approximately 2100 square miles. In terms of major watersheds, the area covers a portion of the Crow Wing and Upper Mississippi River watersheds.

While this study has focused on Crow Wing County, the portions of neighboring counties included in this study have undergone the same rigorous analysis and the recommendations in this report can be carried into the study areas outside of Crow Wing County. Throughout this report, the study region will also be referred to as the "study area," "Brainerd Lakes Area," "Brainerd area," and "Brainerd Lakes Region."

Map 1 - BLACC Study Area & Reference Map

Brainerd Lakes Area Conservation Collaborative



The study region covers approximately 1.34 million acres or nearly 2100 square miles, larger than the state of Rhode Island.

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The collaborative identified a series of watersheds that includes all of Crow Wing County and extends into portions of Cass, Morrison, Aitkin, and Hubbard counties to include in the study area.

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Data source: MN DNR Online Data Deli, MNDOT
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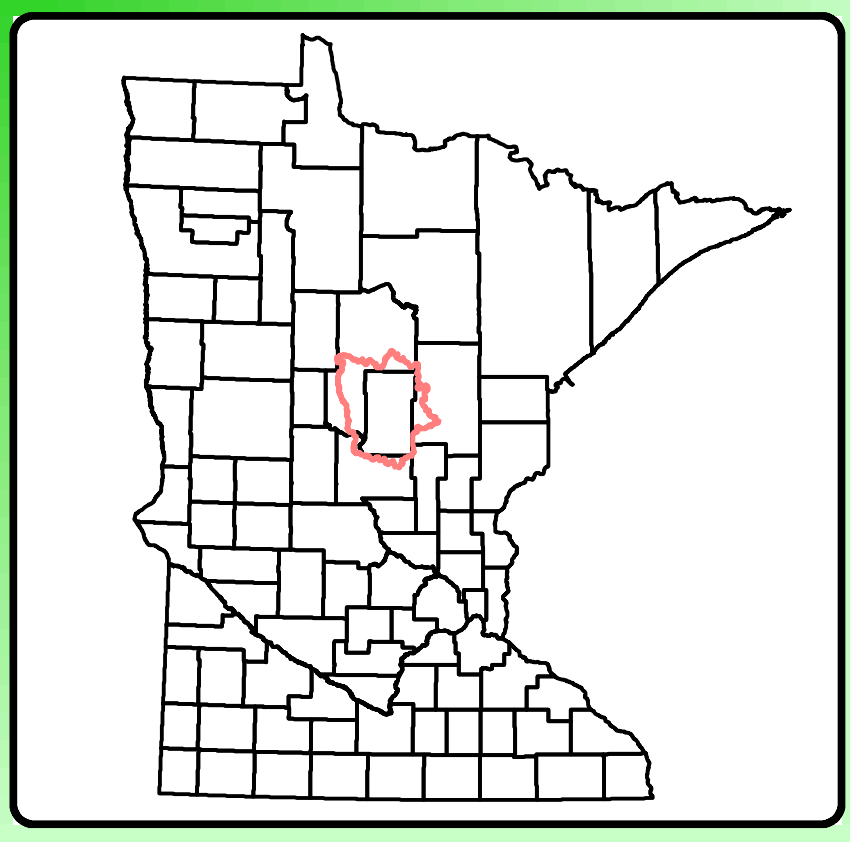


The Brainerd Lakes Area is a dynamic and highly valued region of Minnesota. In order to understand the conditions and character of the study area, this section describes the changing demographics in the region, as well as current land use, cover, and ownership.

Land Use/Land Cover

The study region covers approximately 1.34 million acres or roughly 2100 square mile—larger than the state of Rhode Island[2]. The study region has nearly 2200 lakes or wetlands of at least ten acres in size, and the surface area of lakes and wetlands covers more than one quarter of the entire study region. In 1996, the most recent land cover/land use data freely available, only 2.4 percent of the study area was defined as developed while approximately 76 percent was either forested, open water, or other wetlands (Map 2A, Table 1)[3].

Table 1 – 1996 Land Use/Land Cover

Land Use/Land Cover	Acres	Percent
Forest Land	669,942	49.93%
Open Water and Wetlands	361,160	26.92%
Hay/Pasture/Grassland	221,443	16.50%
Agriculture/Cultivated Land	32,809	2.45%
Urban and Rural Development	32,589	2.43%
Brushland	20,099	1.50%
Mining	3,706	0.28%
Other	76	0.01%
Total	1,341,824	100.00%

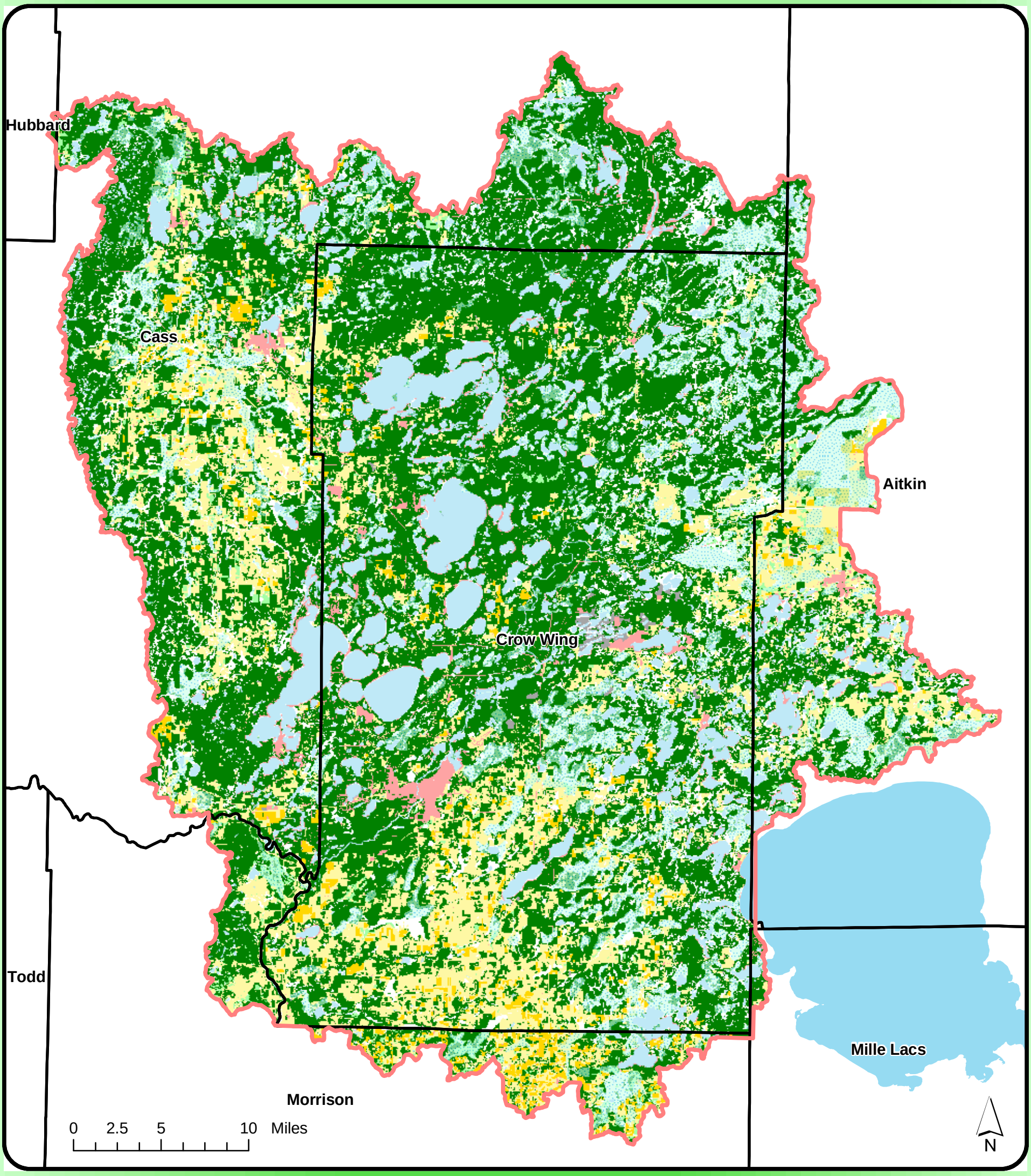
Although developed land uses comprise a relatively small amount of land in the Brainerd area, development can and does have a larger impact, commonly called a footprint, than the acres or percentage suggests. Roads, individual sewage treatment systems (septic systems), fragmented natural habitats due to roads, increased recreational needs, and impervious surfaces are just some of the stresses that undeveloped areas face from developed lands. Since the most recent land use/land cover data is from 1996 and since the number of people per household is declining, the percent of developed land is likely to increase faster than the population rate and is probably already higher than the percent of developed land stated in Table 1.

While there is a significant amount of relatively undisturbed lands in the study area, that number can also be deceiving. Transportation networks ranging from major highways to gravel roads fragment forest lands and some aquatic systems, which makes habitats for many types of animals much smaller since roads and highways act as barriers to some species. Furthermore, very little of the original forest stands remain. Much of the forested land in Crow Wing County and throughout Minnesota has been logged at one time or another. The remaining pre-settlement

[2] Netstate.com
[3] DNR Online Data Deli: LandSat Based Land Use/Land Cover (Vector)

Map 2A - Land Use/Land Cover

Brainerd Lakes Area Conservation Collaborative



Land Use/Land Cover	Acres	Percent
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Mining	3,706	0.28%
Other	76	0.01%
Total	1,341,824	100.00%

- Urban and Rural Development
- Cultivated Land
- Hay/Pasture/Grassland
- Brushland
- Forest land
- Mining
- Lakes or Open Water
- Wetland

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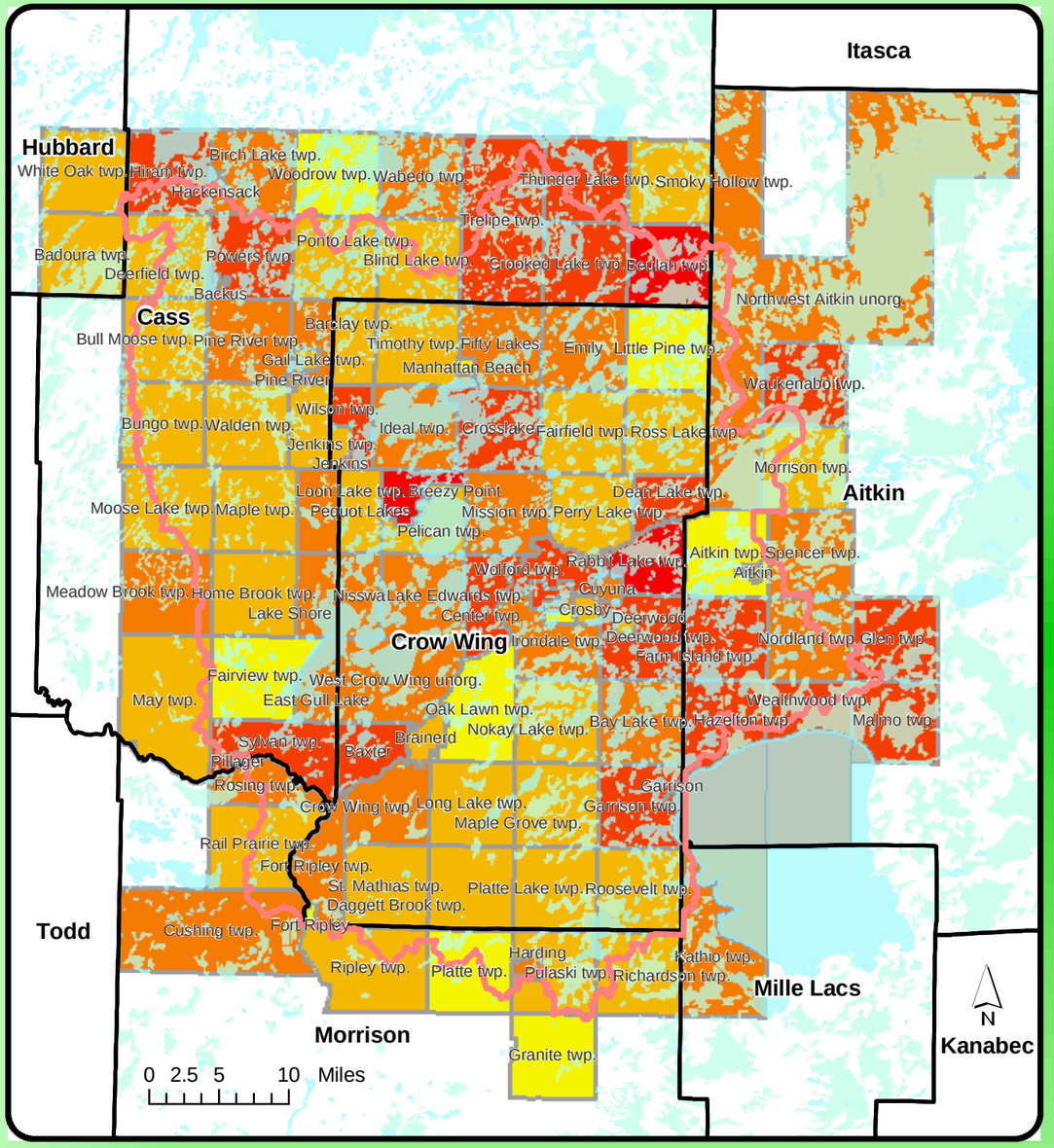
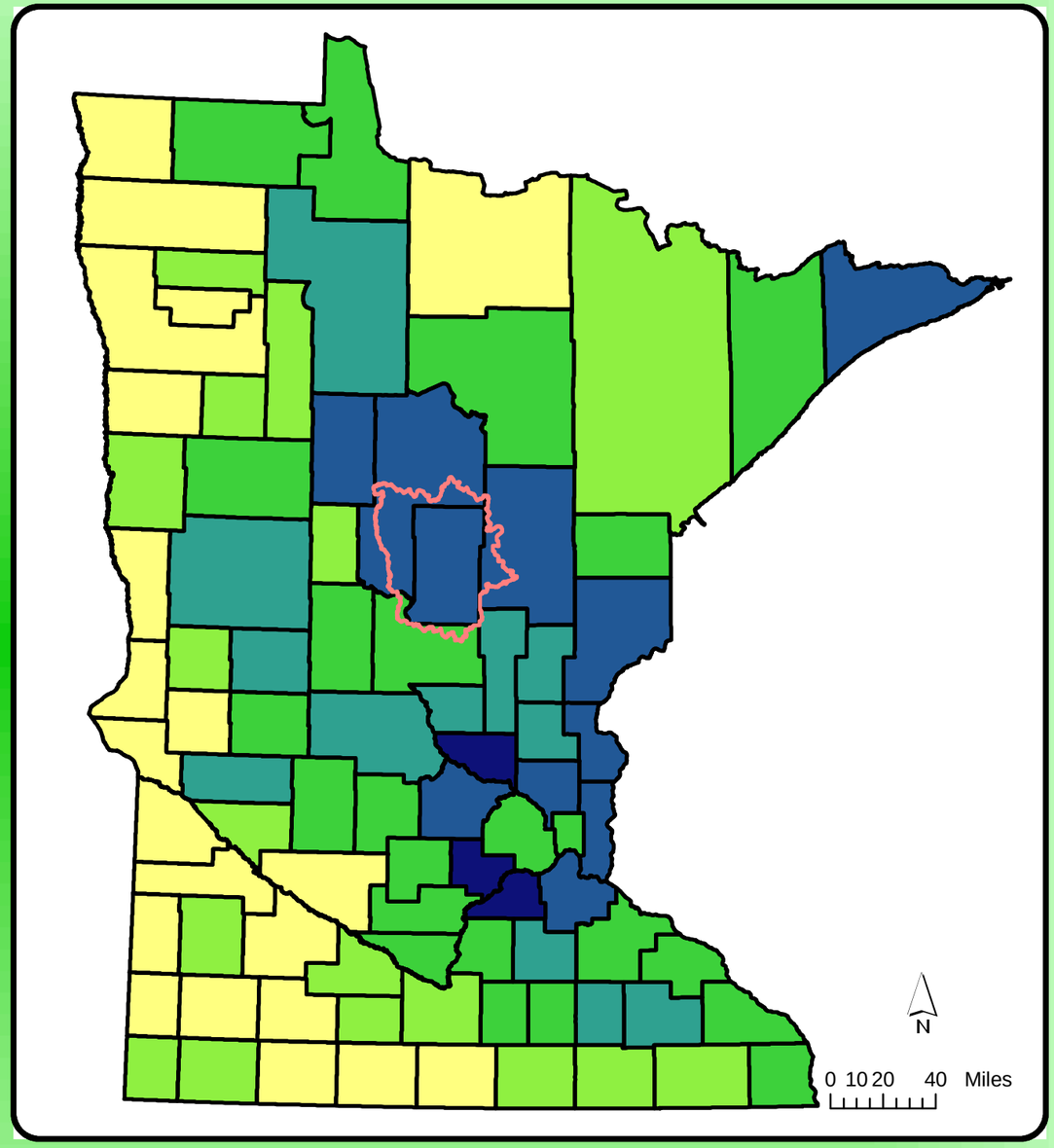
Compiled by: James Lehnhoff

Brainerd Lakes Area Conservation Collaborative

Map 2B - BLACC Population Growth 1990-2000



Map 2C - Minnesota Population Growth 1990-2000



% Pop Change 90-00

- -25 - 0
- 1 - 24
- 25 to 43
- 44 to 67
- 68 to 127

Top 5 Crow Wing County Cities or Townships in Percent Growth 90-00

Rank	City or Township	% Growth	Abs Growth
1	Breezy Point	127%	547
2	Rabbit Lake Twp.	84%	159
3	Crosslake	67%	761
4	Garrison Twp.	63%	308
5	Center Twp.	56%	291

Top 5 Crow Wing County Cities or Townships in Absolute Growth 90-00

Rank	City or Township	% Growth	Abs Growth
1	Baxter	50%	1860
2	West CW Unorg.	31%	1246
3	Brainerd	7%	875
4	Crosslake	67%	761
5	Nisswa	40%	562

% Pop Change 90 - 00

- -12 - -3
- -2 - 4
- 5 - 11
- 12 - 21
- 22 - 38
- 39 - 55

Study Area % Growth Rank 90-00

Rank	County	% Growth
9	Cass	25%
10	Crow Wing	25%
12	Aitkin	23%
16	Mille Lacs	20%
41	Morrison	7%
of 87	State	12%

For distribution with "Inventory and Assessment of Natural Resources in Crow Wing County: A Framework for Conservation and Recreation Planning" Brainerd Lakes Area Conservation Collaborative, 2004

Data source: MN DNR Online Data Deli
1990 & 2000 US Census of Population and Housing

Compiled by: James Lehnhoff

forest stands are isolated and highly sensitive to development. They are the last reservoir of important habitats for many species. Fragmentation increases the opportunity for invasive species to overtake native communities, increases edge habitat reducing the interior forest habitat required by many species and making them more susceptible to predation, makes it difficult for species that require different types of habitats to access both terrestrial and aquatic habitats, leads to more human/animal conflicts, and makes small plant and animal populations vulnerable to local extinctions due to catastrophic events including disease outbreak, drought, fire, or severe storms.

Demographics

This project is particularly important because of the rapidly growing population and housing units in the Brainerd Lakes Region. While population growth can be good for the local economy, it can also increase the strain on existing recreational and natural resources due to increased demand and expansion. From 1990 to 2000 the median growth rate for the 105 municipalities in the study region was 28 percent with a range of 127 percent growth in Breezy Point to a 25 percent drop in Aitkin Township (Map 2B, Table 2)[4]. In absolute terms, the population in the study region's municipalities increased from approximately 67,000 people in 1990 to nearly 84,000 people in 2000. Crow Wing County increased from 44,355 people in 1990 to 55,189 in 2000 or a 24 percent increase (Table 3).

Table 2 - Top 5 Crow Wing County Cities or Townships

Percent Growth 1990-2000

Rank	City or Township	% Growth	Abs Growth
1	Breezy Point	127	547
2	Rabbit Lake Twp.	84	159
3	Crosslake	67	761
4	Garrison Twp.	63	308
5	Center Twp.	56	291

US Census Bureau

This compares to a statewide growth rate of 12 percent over the same period (Map 2C). By 2030, Crow Wing County is expected to grow to over 90,000 people or a nearly 63 percent increase from 2000, which is more than the population in the entire study region today. By comparison, Minnesota expects a 25 percent increase during the same time[5].

Table 3 - Study Area % Growth Rate

Rank	County	% Growth
9	Cass	25
10	Crow Wing	25
12	Aitkin	23
16	Mille Lacs	20
41	Morrison	7
of 87	State	12

US Census Bureau

In most Minnesota cities and townships, housing unit growth is faster than population growth. In Crow Wing County, however, the percent of housing units added was actually below the population growth rate from 1990 to 2000. Although housing growth was technically lower than population growth, the comparison is somewhat deceiving. The Census does not take into account the number of seasonal or resort cabins that were converted to year-round housing units or were torn down and rebuilt as year-round housing units. When adjusting for the increase in year-round housing units, the number of year-round, permanent housing units actually increased 29 percent, which is faster than the average state housing unit growth (12 percent), county population growth (25 percent), or state population growth (12 percent). A faster housing unit growth than population growth has the potential to spread the impact of development across a larger area.

[4] Unless otherwise noted, all demographic information is from the 1990 and 2000 Census of Population and Housing.

[5] Minnesota State Demographic Center: Minnesota Population Projections 2000-2030

Public Land Ownership and Publicly Managed Land

Approximately 28 percent of the study region is publicly owned by a number of governmental agencies ranging from the county to the federal level (Map 3, Table 2)[6]. Private individuals and organizations own the remaining 72 percent of land. The percent of state and federal land is actually below the state average of 11 and 13 percent respectively. The six counties within the study region own or manage just over 17 percent of the land, and the state owns nearly eight percent of the land. Crow Wing County owns approximately 14 percent of its land. Most of the publicly owned land lies along the western and northern portions of the study region in two state forests. The only federally owned land is Camp Ripley Army National Guard base in the southwestern portion of the study area (Map 3)[7]. Public lands provide potential opportunities for connecting natural habitat corridors and creating recreational opportunities at lower costs.

Table 4 - Public Land Ownership & Large Private Lands in the Study Region

Owner	Acres	% of Region
County	235,190	17.53%
State	101,604	7.57%
Federal	33,738	2.51%
Large Private Holdings	48,507	3.62%
Non-gov't Orgs.	1,114	0.08%
Indian Reservations	192	0.01%
Total	420,345	31.33%

MN DNR

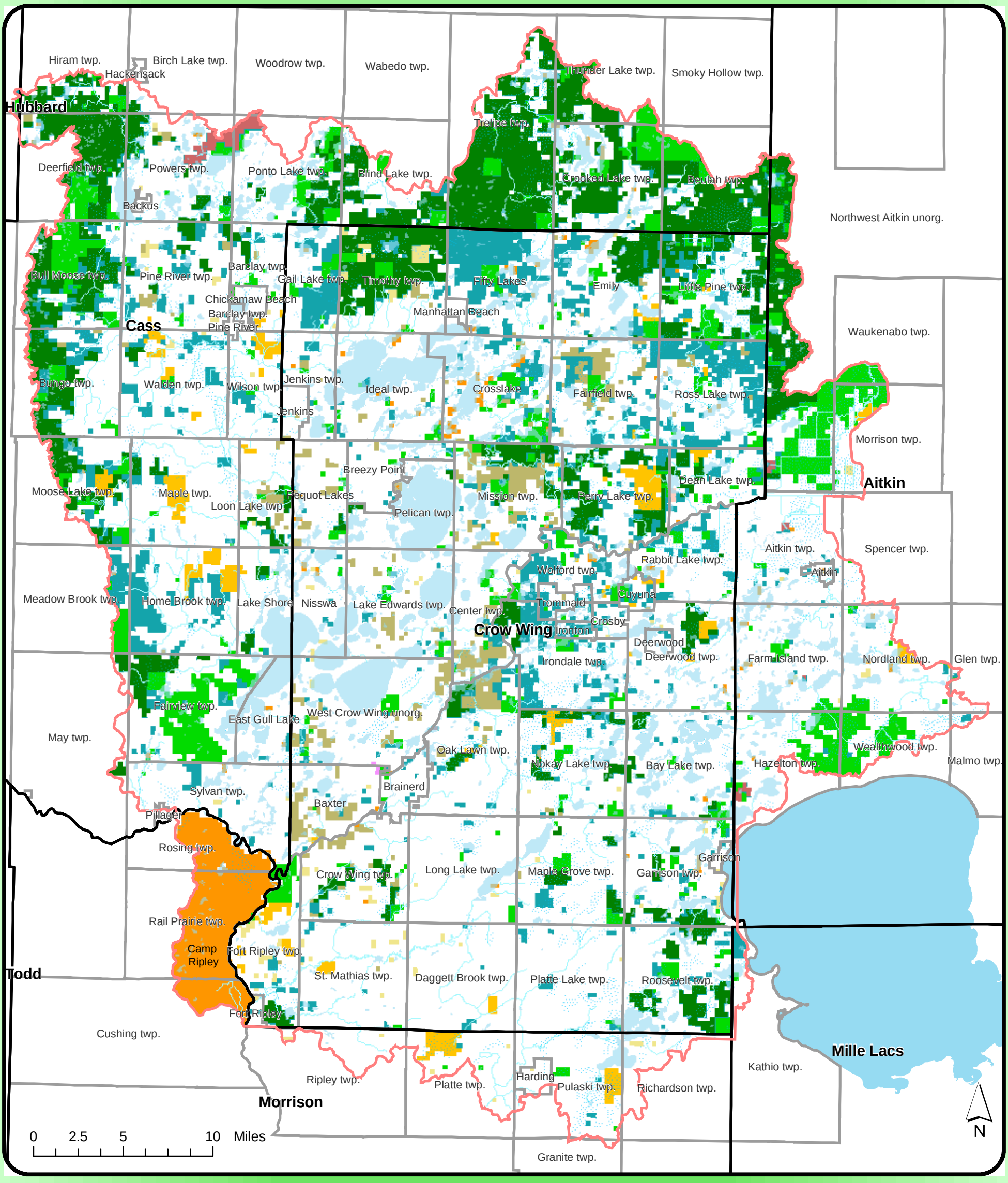
Although not all of the lands in state forests or parks are actually owned by the public, there are a number of state forests, county forests, state parks, and county parks in the study area. The study region is home to the Crow Wing State Park and Cuyuna State Recreation Area (Map 4)[8]. In addition to the state parks, there are eight state forests: Badoura, Crow Wing, Emily, Foothills, Hill River, Pillsbury, and Wealthwood[9]. The Minnesota Department of Natural Resources also manages 23 Wildlife Management Areas (Map 4)[10]. Wildlife management areas (WMA) are used for wildlife habitat and can be used for timber harvesting. In addition to the state and county lands, the cities and townships own a number of parcels for city parks, beaches, and campgrounds; unfortunately, much of this data is not yet available in electronic format.

Crow Wing and its neighboring counties are in the midst of change. Population growth and continued development are changing the character of the area. The remainder of this report identifies potential conservation priority areas, current and potential recreational resources, stresses on natural systems, stresses on recreational resources, and the suitability for development across the region.

[6] DNR Online Data Deli: GAP Stewardship. Numbers are approximate and based upon available GAP Stewardship data.
[7] Ibid
[8] MNDOT: State Parks
[9] MNDOT: State Forests
[10] DNR Online Data Deli: Wildlife Management Area Boundaries

Map 3 - Public Land Ownership & Large Private Holdings

Brainerd Lakes Area Conservation Collaborative



County Forest Land	DNR
County Park	Federal Government
Misc. County Land	Non-Government Orgs.
Large Private Holdings	Native American
Potlatch	State Government

Owner	Acres	% of Region
County	235,190	17.53%
State	101,604	7.57%
Federal	33,738	2.51%
Large Private	48,507	3.62%
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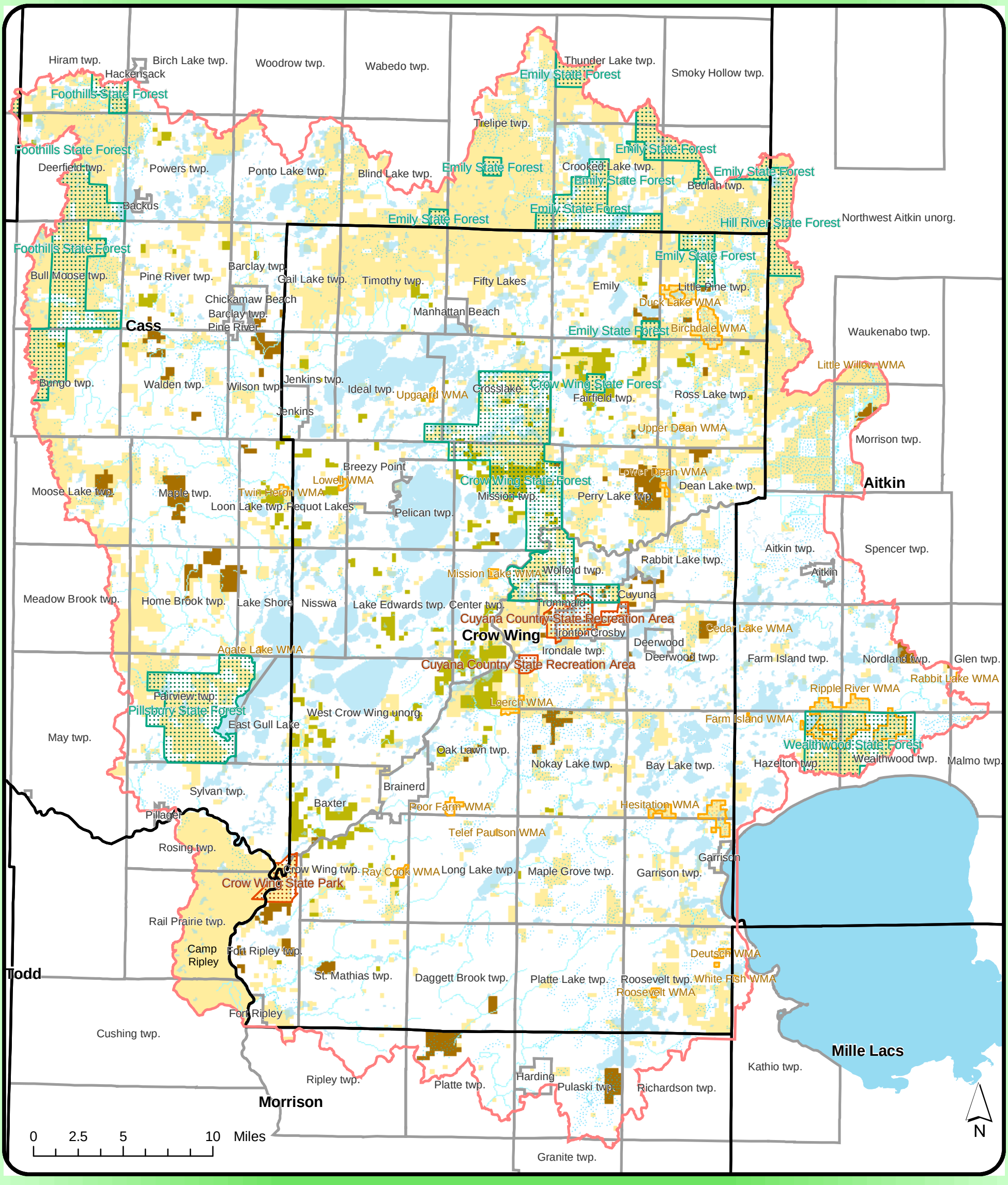
Data source: MN DNR Online Data Deli

Compiled by: James Lehnhoff

Map 4 - Publicly Managed Lands

Brainerd Lakes Area Conservation Collaborative



State Forest
State Park
DNR Wildlife Management Area
Public Land
Potlatch Lands
Other Large Private Holdings

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Brainerd Lakes Area Conservation Collaborative, 2004

Data source:
MN DNR Online Data Deli, MNDOT

Compiled by: James Lehnhoff

HEALTHY NATURAL COMMUNITIES

Virtually all natural environments contain some important value, though not all natural environments are equal in value. Some locations in the study area are home to more unique or significant features than other locations. In areas of increasing population and development, it is important to identify specific areas of high diversity and ecological value that should be protected from certain types of development or all development in some cases.

The Healthy Natural Communities analysis identifies high value terrestrial environments, high value aquatic environments, and primary habitats for two key indicator species. Although the high value terrestrial section focuses on terrestrial habitat conservation, terrestrial habitat is directly linked to aquatic environments. The data from the terrestrial resources section are combined to produce a potential priority conservation map and recommendations that focuses on terrestrial areas but encompasses aquatic resources.

While the potential conservation map for terrestrial resources is meant to provide broad recommendations for conserving land and water resources, the high value aquatic section provides a higher level of detail meant to help decision makers select more specific water resources for protection or conservation.

This report is not suggesting that all development in the potential conservation priority area or all aquatic resources should be restricted from development. This report does suggest, however, that different and more compatible types of development are needed in these potential conservation areas to preserve the character of the Brainerd Lakes region. In some locations, development that uses cluster patterns, preserves green space through easements or deeds, or other innovative tools may be the most effective conservation strategies.

High Value Terrestrial Resources

Over two-thirds of the study area is covered in forests, brush, or grasslands; however, some parts of the region host particularly remarkable terrestrial and aquatic habitats. Since human development directly competes with other types of undisturbed land cover, it is imperative to identify areas that are particularly sensitive to development in order to protect them and design development that is compatible with high value terrestrial and aquatic environments. As mentioned above, the terrestrial analysis includes some aquatic data in the analysis and the overall recommendations. Data used to identify high value terrestrial environments include potentially high value forest stands, rare and threatened species, county biological survey data, a lake use analysis, and important riparian habitat.

High Value Forest Lands

Identifying potentially high value forestlands is difficult without actually visiting and inventorying the forests. This analysis used two techniques to identify where potential high value or old growth forest stands may still exist. While much of the forested lands in the

Brainerd Lakes Region were harvested at some point in the past, some areas of pre-settlement forest stands may still exist in fragmented locations (Map 5A). Potential pre-settlement forest stands were located using common forest inventory data and the pre-settlement vegetative cover data from the Minnesota Department of Natural Resources[11]. Common forest inventory data contains current forest type on public lands. Pre-settlement forest data show a general forest type for an area collected during the land surveys in the 19th century. The pre-settlement forest data is not as detailed or as accurate as the common forest data; however, it is available almost statewide and is the best publicly available data. Potential pre-settlement forest stands exist where the type of current forest stand on public land matches the forest type in the pre-settlement data (Map 5A).

Other possible high value forest stands were identified by selecting tree species from the common forest inventory data, such as hardwoods, pines, and spruces, which were considered important in the common forest inventory data but did not match the pre-settlement forest data (Map 5A). Since these areas were identified without visiting the actual sites, this analysis should be considered as an indicator of potential original stands and possible high value forest areas. The pre-settlement contains errors and greatly generalizes forest type. The common forest data under represents private lands where data is currently unavailable.

Rare and Threatened Species & Biodiversity

The Natural Heritage database is managed by the Minnesota Department of Natural Resources (DNR) and identifies the locations of endangered, threatened, and rare plants and animals throughout Minnesota[12]. Restrictions from the DNR do not allow the release of specific species locations; therefore, the data is displayed using the density of natural heritage species (Map 5B). Areas of high concentration are particularly important for protection in order to maintain a high level of biodiversity. While this is the best data available showing where species of concern were found, the data tends to over represent public lands and where researchers have been able to scout for these species.

The Minnesota DNR recently conducted a survey of rare biological features and their associated ecosystems in Crow Wing, Cass, and Morrison Counties (Appendix A). The survey combines data on rare plants, native plants, and rare animals to delineate important biological habitats in both aquatic and terrestrial realms (Map 5C). Although the data was still being processed as of August 2004, the DNR has identified areas of below, moderate, high, and outstanding biodiversity in Crow Wing, Cass, and Morrison Counties. These areas are particularly sensitive to development, fragmentation, and certain recreational activities.

Lake Use Analysis

For the purposes of this analysis, a basic lake use analysis was conducted that classified the region's lakes into three use categories: Active Use lakes, Wildlife/Natural lakes, and Opportunity lakes (Map 5D, Appendix B). "Active Use" lakes are those lakes that already have a significant amount of development and public boat access, which makes them good candidates

[11] DNR Online Data Deli: Common Forest Inventory & Pre-settlement Vegetation.
[12] DNR Online Data Deli: Minnesota County Biological Survey.
http://www.dnr.state.mn.us/ecological_services/nhnrp/nhis.html

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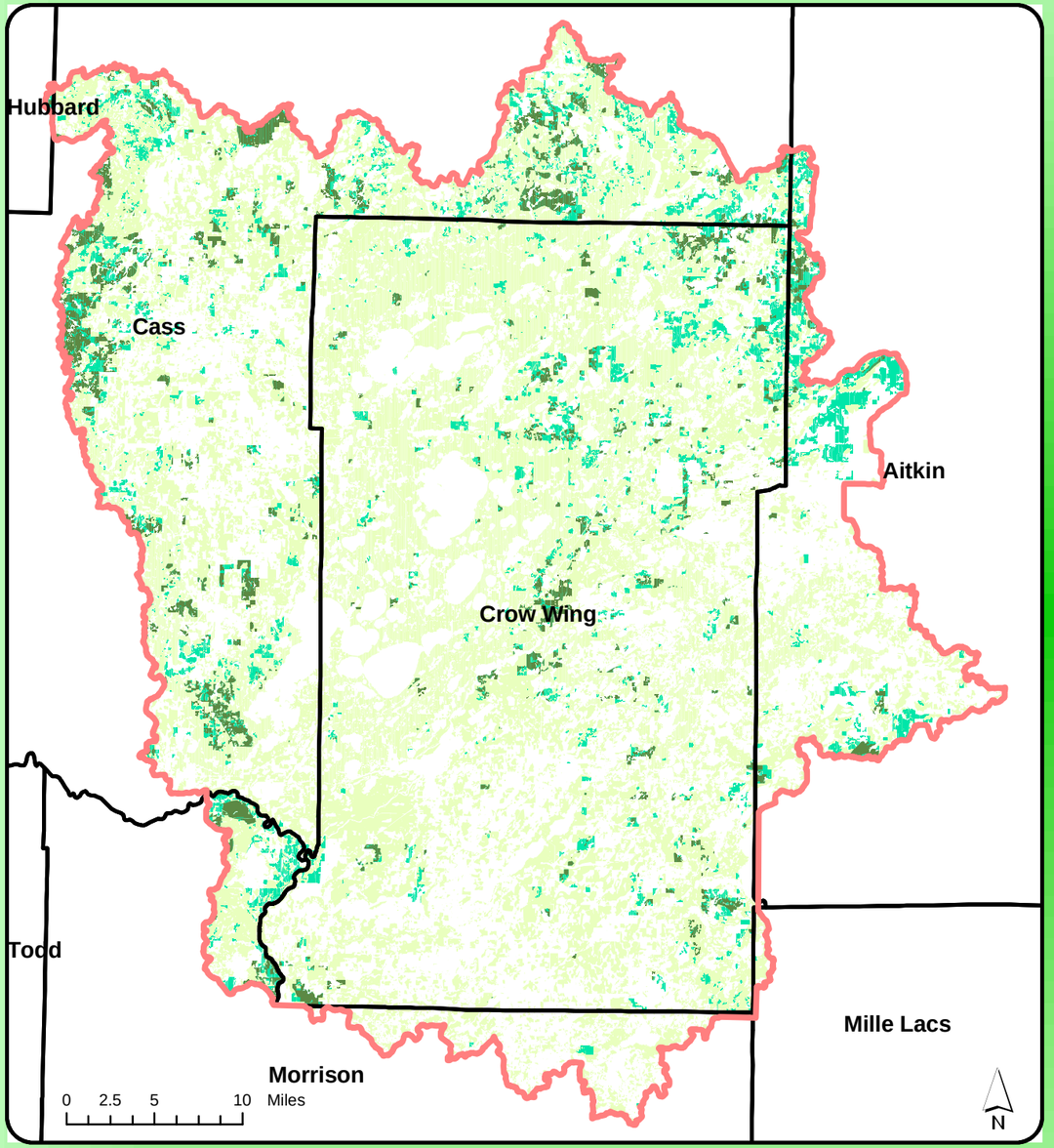
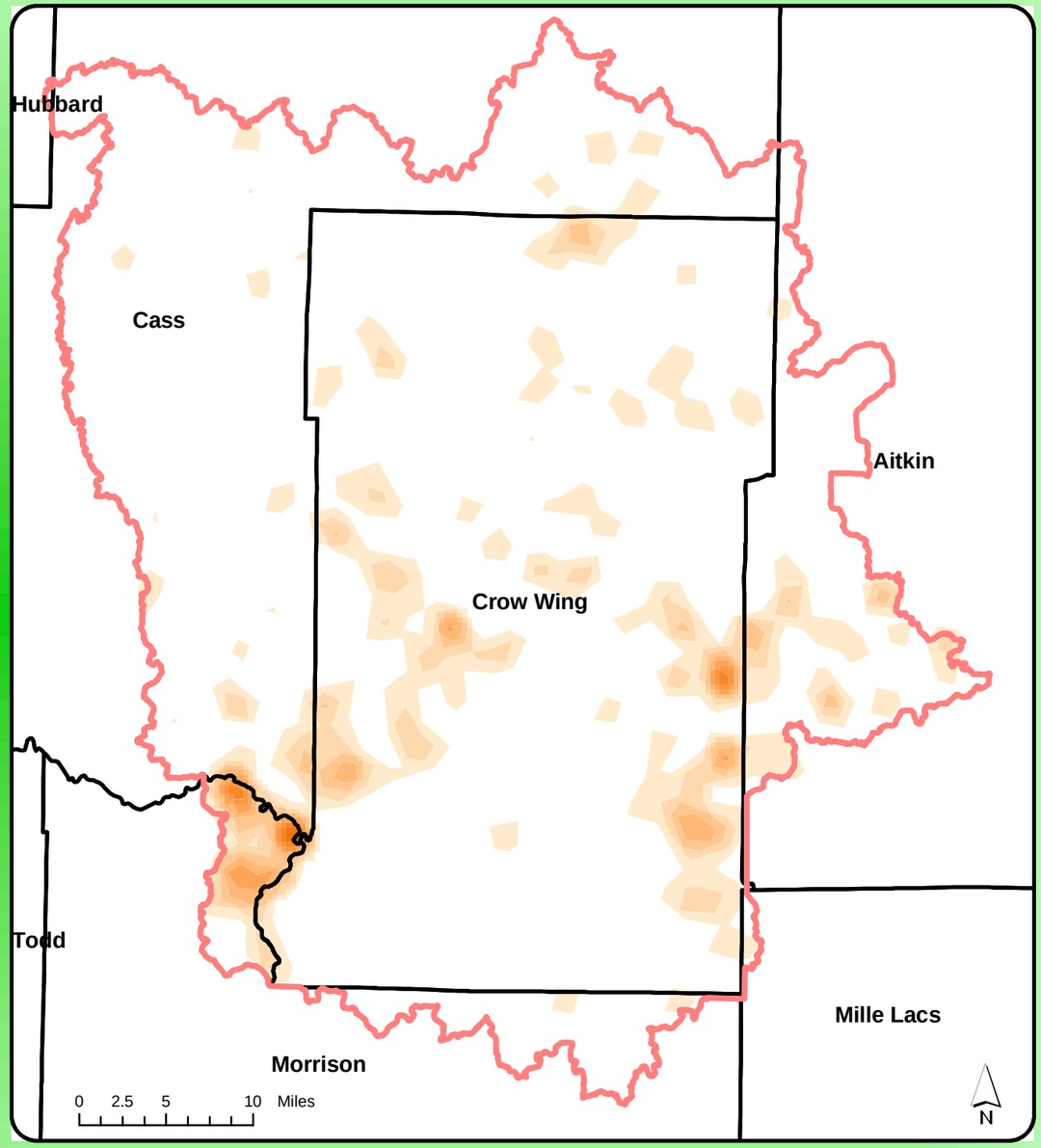
Map 5A - Possible High Value Forest Stands



Map 5B - Natural Heritage Species Density



Potential Original Forest Stands
Possible High Value Forest
Other Forested Areas

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Endangered Species Concentration

High Concentration | | | | | | | Low Concentration

Data source: MN DNR Online Data Deli
Minnesota Natural Heritage Database
Compiled by: James Lehnhoff

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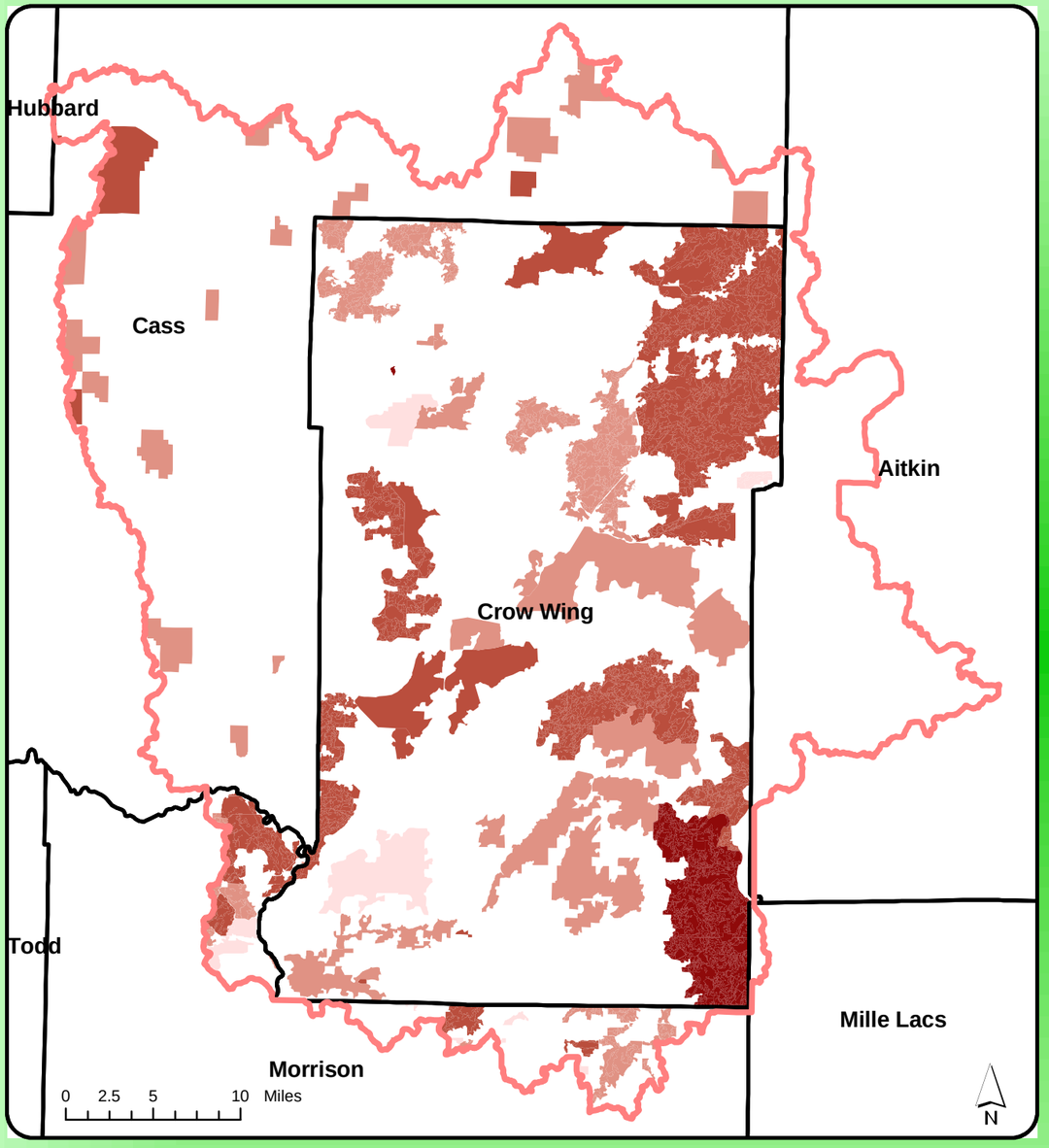
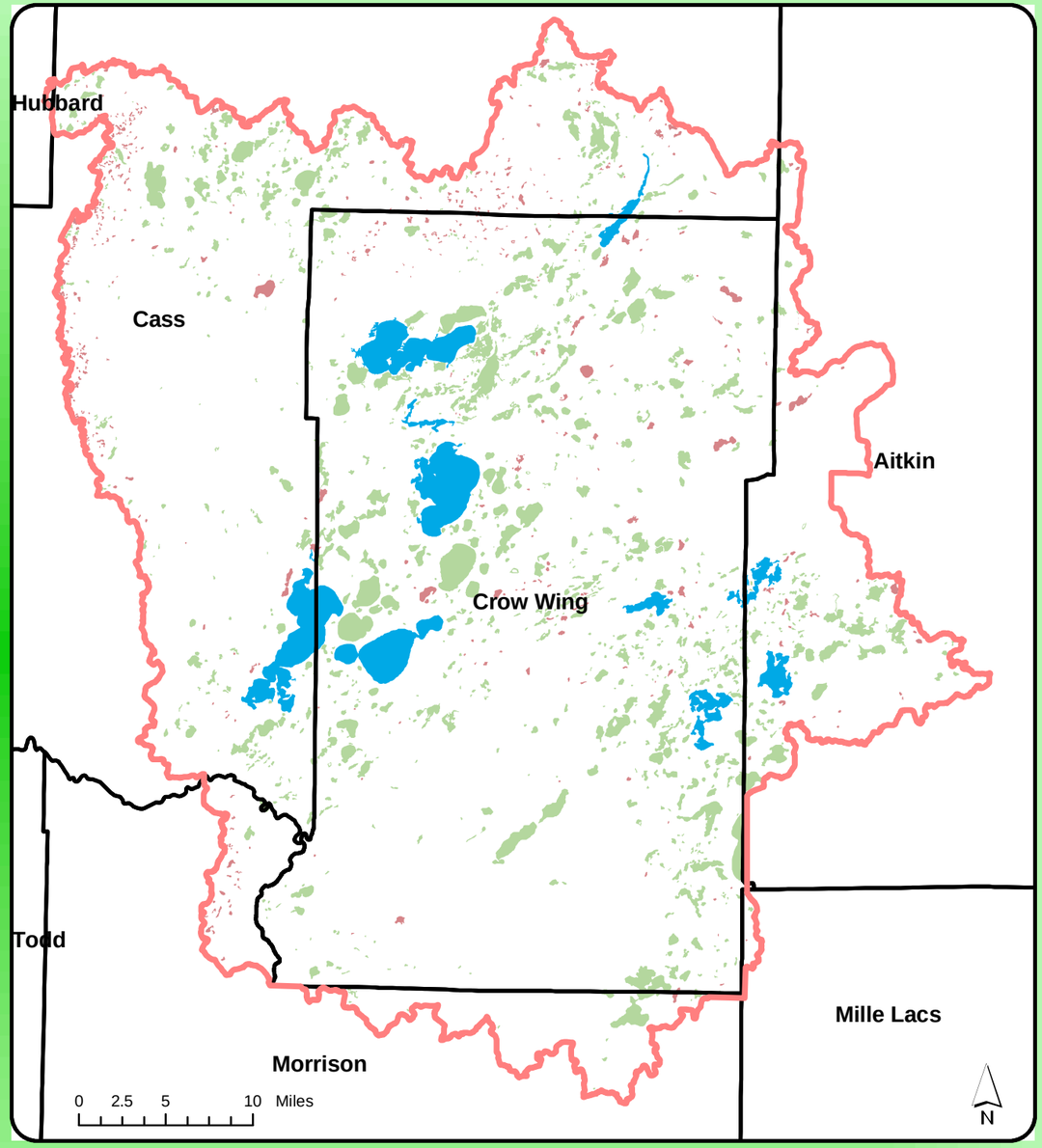
Map 5C - County Biological Survey



Map 5D - Lake Use Analysis



County Biological Survey

Biodiversity Significance

- Outstanding
- High
- Moderate
- Below

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Data source: MN DNR Online Data Deli,
Minnesota County Biological Survey
Compiled by: James Lehnhoff
CBS Data is in draft form and not available for Aitkin County

Lake Use Classification

- Active Use Lakes
- Opportunity Lakes
- Wildlife/Natural Lakes

Active Use Lakes - Highly developed lakes with little public land, at least one boat access, and used for active recreation

Opportunity Lakes - Some development with public land, some have boat accesses, used for recreation and natural purposes

Wildlife/Natural Lakes - Little to no development, surrounded by public land or abundant public land nearby, few have boat accesses, lake type less suited for recreational purposes

for continued and possibly expanded recreational use, particularly for fishing, boating, and swimming beaches. However, virtually all "active use" lakes have very little remaining public land along the shores and face increasing development pressure.

"Opportunity" lakes have less development than the Active Use lakes and could be used for more development, recreation, or open space/wildlife preservation depending on shoreline conditions, boat access, water quality, available public land around the lake, and demand. The aquatic analysis provides more specific data for helping to decide the best future use for many Opportunity lakes.

The "Wildlife lakes" have very little or no development, are completely surrounded or have significant publicly owned lands nearby, and have a water type (e.g. shallow, murky, weedy, etc.) that tends to make them less desirable for development or recreation and possibly better suited for conservation. Opportunity lakes and Wildlife lakes help connect terrestrial habitats and are an integral part of a healthy terrestrial environment.

Important Riparian Habitat

Finally, isolated wetlands and riparian habitats are unique ecological areas that are relied upon by both aquatic and terrestrial species (Map 5E). Isolated lakes and wetlands are easily harmed by development because of their relatively closed system and inability to flush contaminants out of the enclosed system, which makes them more vulnerable to contaminants than some other types of lakes and wetlands. Isolated lakes and wetlands were identified by locating lakes not connected to the stream and river system[13]. Riparian habitats, those habitats near water, are also important because they provide water access to animal species, connect terrestrial ecosystems to aquatic ecosystems, and provide drainage to the entire study area (Map 5E).

Indicator Species: Blanding's Turtle and the Red-shouldered Hawk

Ecosystems are extremely complicated structures that are exceptionally difficult to study in their entirety, as indicated by the imperfect data sources described above. For this reason, it is common to choose indicator species to act as a surrogate measure of ecosystem health. The presence and the number of a particular indicator species often represent a healthy or unhealthy habitat for a number of other species. If the indicator species for a particular ecosystem is threatened, it is likely that the entire ecosystem is being threatened.

Two species, the Blanding's Turtle and the Red-shouldered Hawk, were identified by the BLACC members as key indicator species in the study region. The Blanding's turtle requires an array of land types including wetlands, shallow lakes and ponds, riparian habitat, and well-drained terrestrial areas for nesting. The turtles' extensive habitat requirements make it an excellent indirect measure of wetland and riparian ecosystem health. The Red-shouldered Hawk is an indirect measure of forest ecosystem health because of its reliance on larger and older hardwood forests. Protecting these two species' habitats is essential to preserving the unique character and complex ecosystems in the Brainerd area for a variety of species.

[13] United States Geological Survey: National Hydrography Dataset

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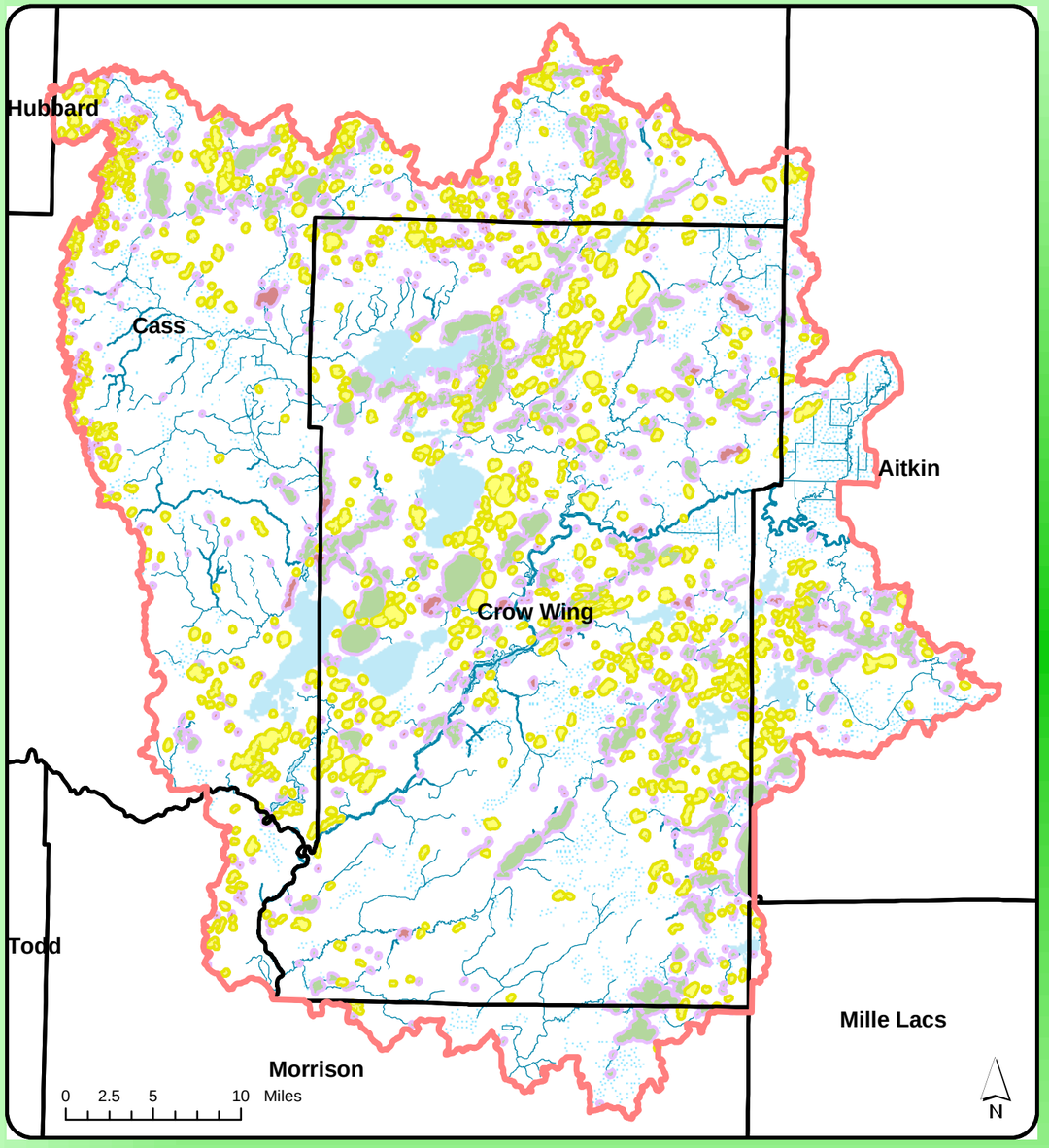
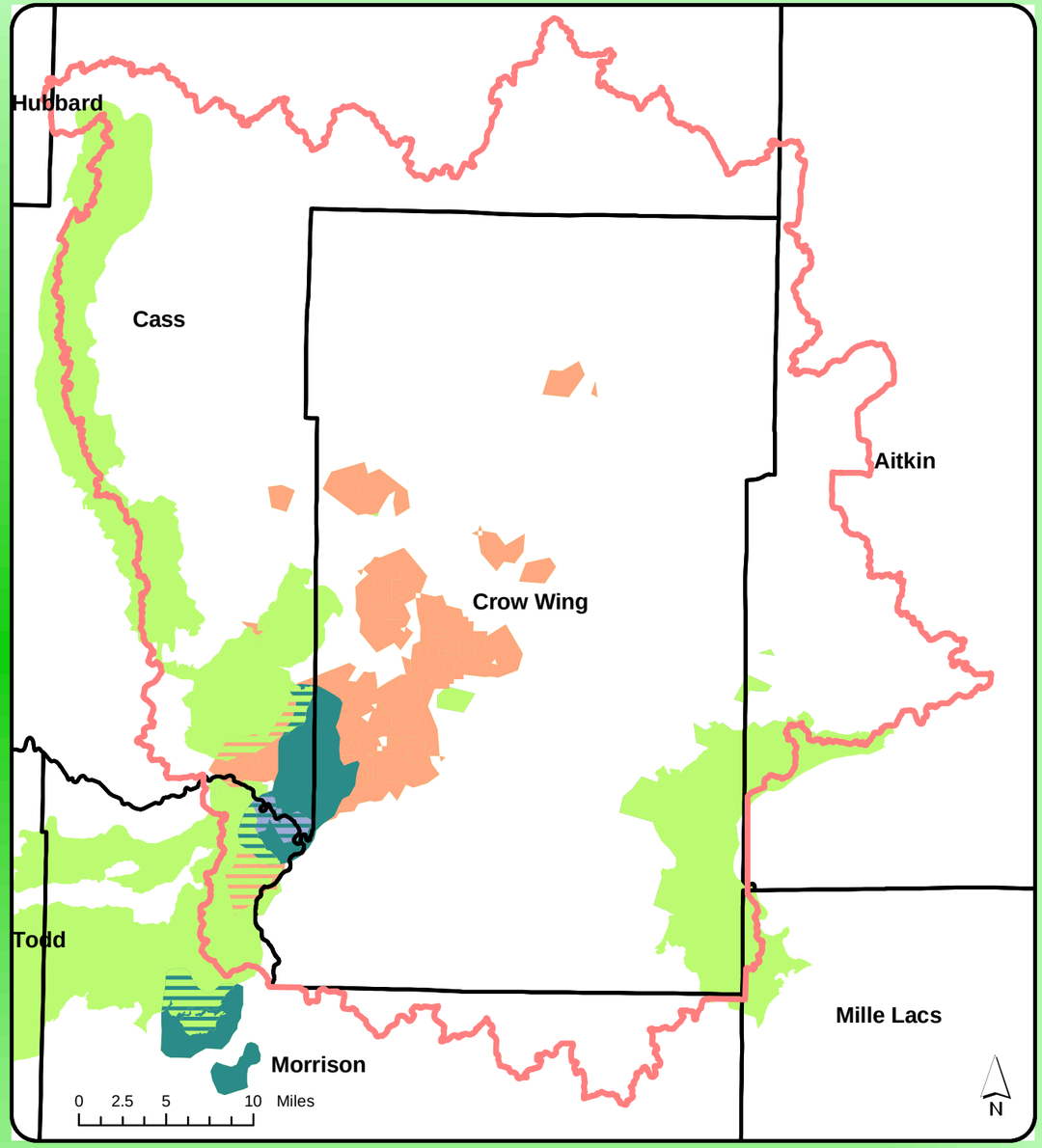
Map 5E - Important Riparian Habitat



Map 6 - Blandings Turtle & Red-shouldered Hawk Habitat



- Wildlife Lakes
- Opportunity Lakes
- Isolated Lakes & Wetlands
- Riverine Habitat
- Isolated Lakes & Wetlands 1000 Foot Buffer
- Other Shoreland Habitat 1000 Foot Buffer
- Other Lakes or Open Water
- Other Wetlands

For distribution with "Inventory and Assessment of Natural Resources in Crow Wing County: A Framework for Conservation and Recreation Planning" Brainerd Lakes Area Conservation Collaborative, 2004

Data sources: MN DNR Online Data Deli, MN DNR Blanding's Turtle and Red-Shouldered Hawk Habitat, National Hydrography Dataset
Compiled by: James Lehnhoff

- DNR Blanding Turtle Priority Protection Area
- DNR Red Shouldered Hawk Priority Protection Area
- Other Blandings Turtle Habitat
- Other Red-shouldered Hawk Habitat

Two data sources were used to identify Blanding's turtle and Red-shouldered Hawk habitat locations. The Minnesota Department of Natural Resources has collected habitat data from on-site visits and identified primary Blanding's turtle and Red-shouldered Hawk habitat areas (Map 6)[14]. While the Blanding's turtle and the Red-shouldered Hawk also live outside of these areas, these locations are where these species are concentrated.

The secondary data comes from the Natural Heritage Database and is based on the density of the selected indicator species in a given location[15]. The areas depicted in Map 6 combine the land and aquatic habitats needed by these two species.

High Value Aquatic Environments[16]

Because the study region covers such a large area and contains more than 2000 lakes and wetlands, it is difficult to provide specific recommendations for terrestrial or aquatic habitats. However, the many lakes and wetlands are a defining factor of the study region and a central part of many planning efforts in this part of Minnesota. The results in the aquatic analysis supplement the terrestrial analysis with more specific data pertaining to aquatic systems and individual lakes to help decision makers guide the future use of individual lakes. Unfortunately, providing more specific data requires more technical methodology and analysis. The basic methodology and results are provided below. Aquatic data is often incomplete and cannot be fully compared from lake system to lake system making a complete analysis difficult.

Freshwater Areas of Biodiversity Significance

Freshwater Areas of Biodiversity Significance (ABS) represent the highest quality examples of each aquatic ecosystem type present within the study area (Map 7A). These aquatic ecosystems cover a relatively large area and are meant to classify systems of lakes and wetlands rather than individual lakes or wetlands. Several base layers were used to identify the Areas of Biodiversity Significance:

- Aquatic system polygons (watersheds) developed based on abiotic factors of rivers and streams of the area, which includes factors such as gradient, geology, and other non-biological values.
- The location of species of concern from the Natural Heritage Database (SOCs).
- National Land Cover Database, exhibiting both natural and converted or developed land use types.
- Various data sources from the DNR, Minnesota Pollution Control Agency, Minnesota Department of Transportation, United States Environmental Protection Agency
- Public lands and many large private holdings.

[14] Minnesota Department of Natural Resources: *Blanding's Turtle and Red-shouldered Hawk Habitat*
[15] Natural Heritage Database
[16] "Aquatic Resources and Conservation Priorities for the Brainerd Area, Minnesota," prepared for The Nature Conservancy and the Brainerd Lakes Area Conservation Collaborative. Written by Roy Weitzell and adapted for this document by James Lehnhoff. For a complete description of methodology and citations, please obtain the full document from The Nature Conservancy (unpublished at the time of this document's release).

Map 7A - Freshwater Biodiversity Significance

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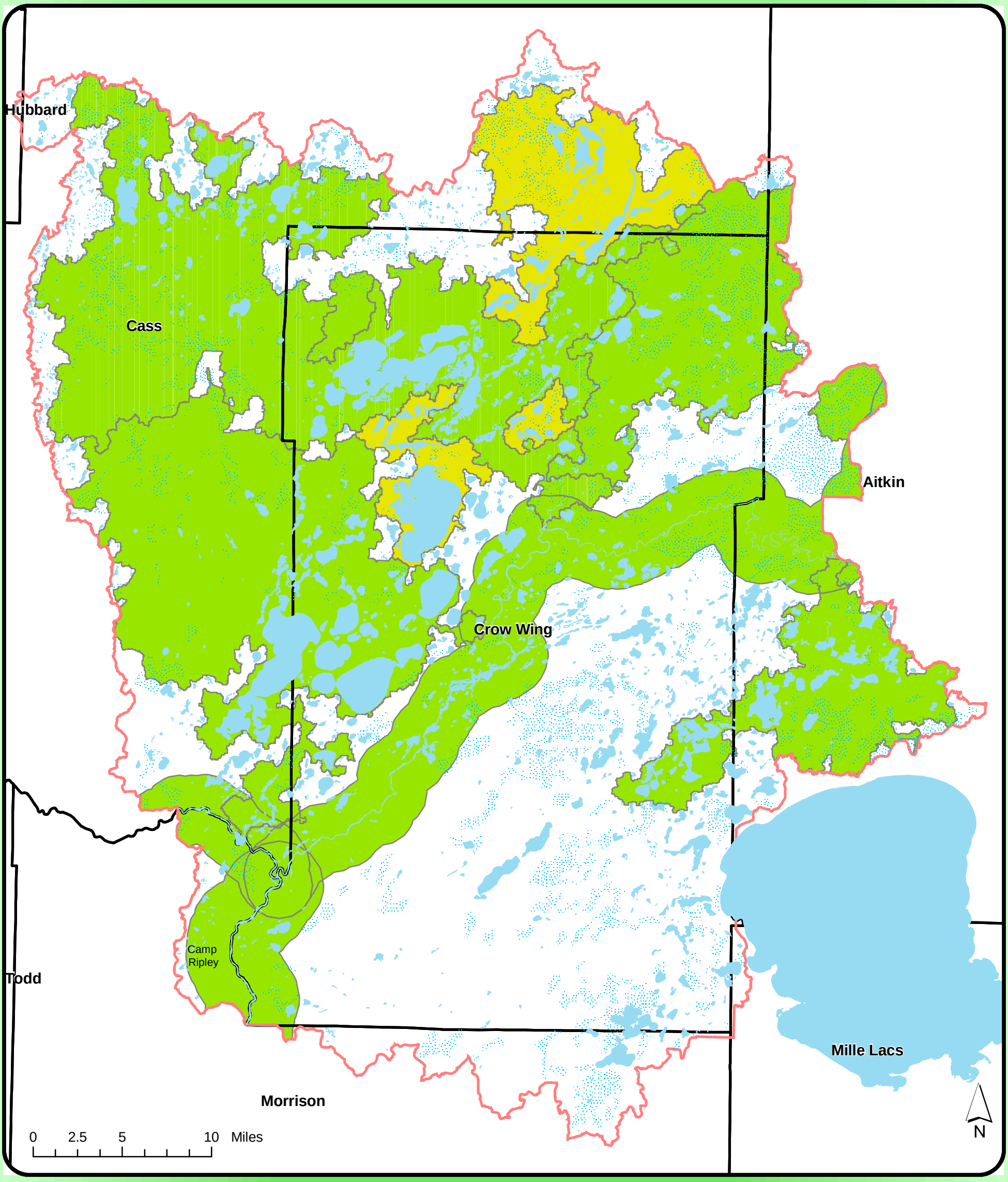

Areas of Primary Freshwater Biodiversity Significance

Areas of Secondary Freshwater Biodiversity Significance

Lakes or Open Water

Wetland

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Map compiled by: James Lehnhoff

- Previously identified conservation areas (e.g., in The Nature Conservancy (TNC) Superior Mixed Forest Ecoregional Plan), where all or a significant part of a previous site overlaps with the aquatic system polygon.
- Expert recommended areas identified for high quality natural communities or populations of species of concern
- Location of invasive species within the BLACC area.

A single example of each system type was then identified as a "Primary Area of Biodiversity Significance (ABS)." In general, a "Primary ABS" constitutes a system that exhibits the largest amount of natural land cover, and the smallest amount of urbanization, agriculture, and other converted land use types.

Areas of high density of dams, roads, and point source pollution (feedlots, landfills, industrial and municipal discharges, leaky underground storage tanks, etc.) and densities within systems were also examined, with lower density systems receiving a higher priority. Special consideration was given for those systems that serve as habitat for species of concern, those species that have been previously identified as important for the conservation of biodiversity, and those species that were identified in the current study as high quality, important areas. The presence of invasive species, especially if they are multiple or widespread, was a significant negative factor in the designation of ABS. In cases where there was only a single example of a particular aquatic system type within the BLACC study area, that system occurrence was automatically designated as a "Primary ABS", and should be targeted for conservation action.

No consideration of social, political, or economic factors was considered in the ABS designation. However, it is possible that these factors could align to discourage action within a "Primary ABS." In some cases, a "Secondary ABS" for a system has been designated, representing an important area of lesser, but still significant quality and biological importance. These "Secondary ABS" should be considered viable alternatives to the "Primary ABS" should the above-mentioned factors prove prohibitive to adequate conservation measures.

Freshwater Biodiversity Density

In order to visualize which areas of biodiversity significance and other aquatic systems within the BLACC study area exhibit the highest concentrations of freshwater biodiversity. A density layer was created using data for the numerous species of concern from the Natural Heritage database inhabiting the region. These data were attributed to the river segments and lakes from which they were sampled.

River segments were defined to include a buffer of 300 feet, and lake segments by 1000 feet, with each of the resultant buffers assigned a biodiversity value based on the number of species of concern found there. The 300-foot and 1000-foot buffers for rivers and lakes, respectively, correspond with the Shoreland Protection Area as defined by the Minnesota Department of Natural Resources in the Shoreland Management Act (1969). Point data not associated with a particular river segment or lake polygon were buffered by 1000 feet and also assigned a biodiversity value. The resultant data layer was then merged with a layer from the Minnesota County Biological Survey exhibiting wetland and wetland forest areas of high and moderate

biodiversity value. The final layer in Map 7B shows the relative density of aquatic species of concern and high value natural communities within the BLACC study area, based upon the extent of current knowledge. This layer could be used to designate "Priority Sub-watersheds" within and outside the "Primary ABS" discussed above.

It must be stated that the absence of aquatic density information for rivers and lakes does not necessarily mean that there are no species of concern or high quality natural communities present in that location. Floral and faunal surveys for the area are not comprehensive, and the spatial and temporal variability in the distribution of some species means that they simply may have been missed during initial surveys. Conservation action should focus on protecting the areas known to have these entities are present, and a concerted effort should be made to fully survey the lakes and streams of the BLACC study area for additional occurrences. Many high quality areas of habitat harboring species of concern and otherwise diverse natural communities undoubtedly exist, despite their not being present in this layer.

Lake Sensitivity and Viability

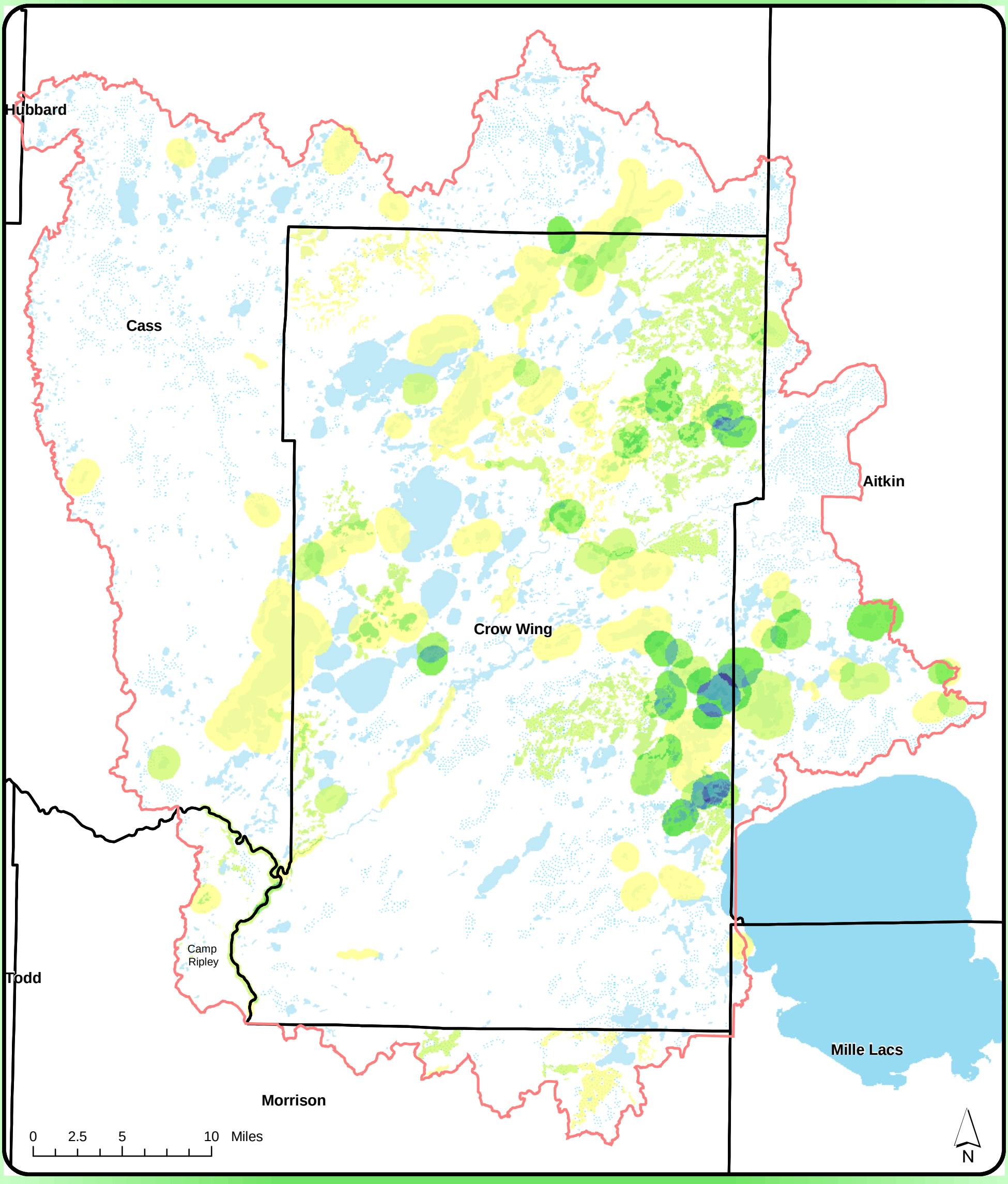
To aid in the selection of lakes within the BLACC study area that exhibit the greatest need for immediate protection or restoration, a series of attributes related to lake sensitivity to development and viability for protection were calculated. Only data that were comprehensive for all lakes within the region were used. There are several additional attributes that, given adequate spatial or tabular data, could provide a much more robust measure of sensitivity and long-term viability. While limited data exists for many of these attributes, there was a concern that using non-comprehensive data sources might lead to the misinterpretation of which lakes should receive conservation priority. This section may be the most useful for helping to determine the future use of Opportunity Lakes defined in the terrestrial analysis.

Lake Sensitivity

Four comprehensive data layers were used to calculate lake sensitivity to development within the BLACC study area (Map 7C, Table 5). Each of the selected factors was given a score; a higher score indicates a greater sensitivity to development. Lake surface area is an important factor, as lakes with a larger water volume can, in general, better assimilate nutrients and other pollutants. The shoreline development index reflects the potential for greater development of riparian and shoreline communities in proportion to the volume of the lake (i.e., the greater amount of shoreline per acre of water surface, the greater the development potential of the lake). The morphology of a lake determines the ability of that lake to assimilate pollutants. For instance, drained lakes (lakes with one or more stream outlets) and drainage lakes (lakes with one or more stream inlets and one or more outlets) have higher flushing rates than isolated lakes (lakes with no inlets or outlets). Finally, the number and types of boat launches present on a lake contribute to the threat of infestation by exotic species. Lakes with ramps that accept trailered boats have a much higher probability of infestation than lakes with carry-in ramps, or those with no ramps at all. Invasive species can out-compete and displace native species, act as vectors for foreign disease, can permanently destroy habitat and fisheries, and disrupt natural nutrient pathways.

Map 7B - Unique Aquatic Habitat Density

Brainerd Lakes Area Conservation Collaborative



Unique Aquatic Feature Density

Higher — Lower

Map created for "Aquatic Resources and Conservation Priorities for the Brainerd Area, Minnesota," by Roy Weitzell. Prepared for The Nature Conservancy and the Brainerd Lakes Area Conservation Collaborative. For a complete description of methodology and citations, please obtain the full document from The Nature Conservancy (unpublished at the time of this map's release).

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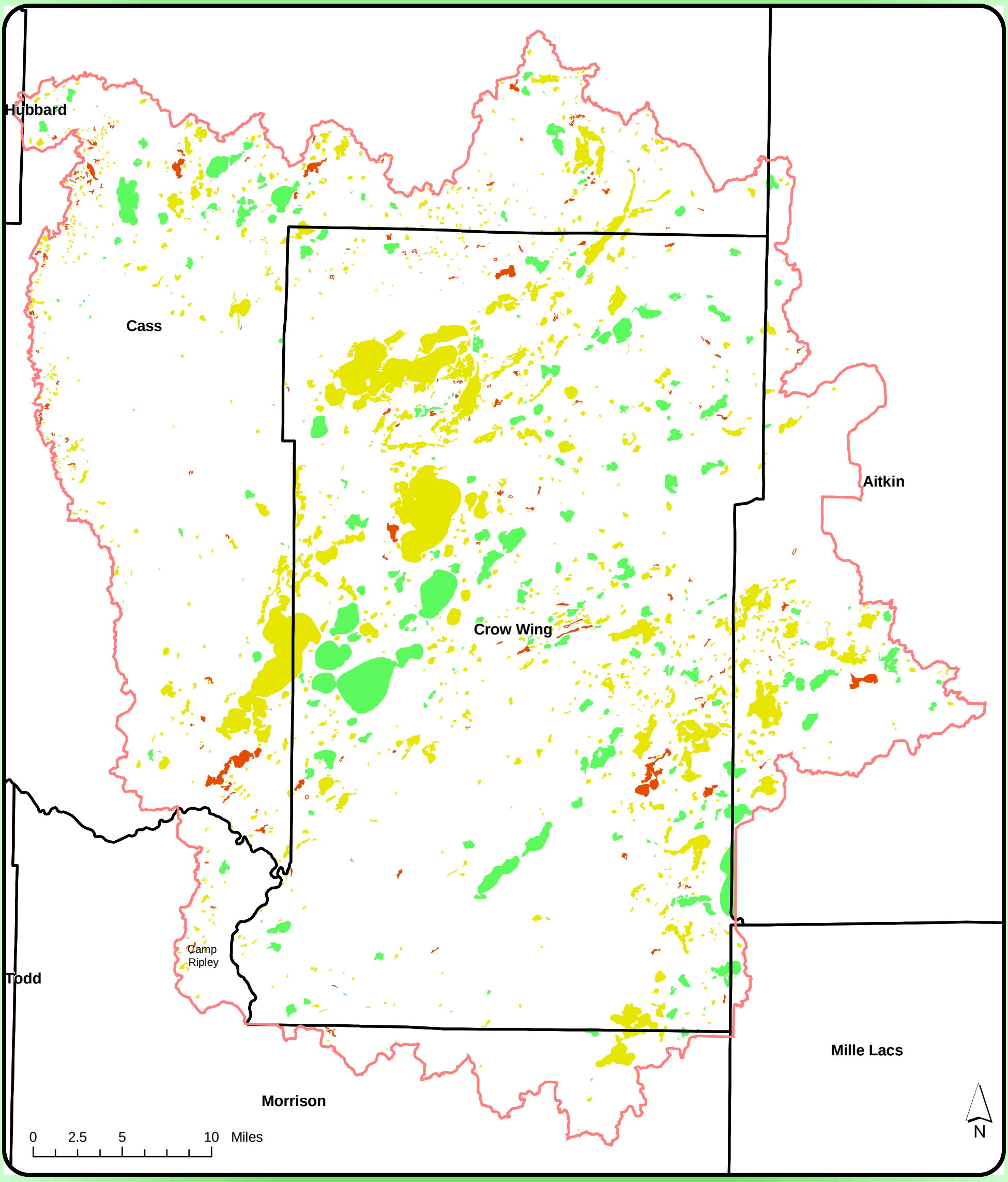
Map compiled by: James Lehnhoff

Map 7C - Lake Sensitivity to Development

Brainerd Lakes Area Conservation Collaborative



Sensitivity to Development

- High
- Moderate
- Low

Lower is Better

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Map compiled by: James Lehnhoff

Table 5 - Lake Sensitivity to Development

Attribute	Classes	Description	Score
Lake Surface Area	1-50 acres	Very small	4
	51-100 acres	Small	3
	101-500 acres	Medium	2
	>500 acres	Large	1
Shoreline Complexity	≥ 3.00	Very irregular	4
	2.00 – 2.99	Irregular	3
	1.50 – 1.99	Somewhat irregular	2
	1.00 – 1.49	Almost circular	1
Lake Morphology	No stream outlet	Seepage	3
	Stream outlet only	Drained	2
	Stream inlet and outlet	Flow-through	1
Public Boat Ramps	>1 trailer ramp	Multiple Trailer	4
	1 trailer ramp	Single Trailer	3
	Carry-in ramp(s)	Carry-in only	2
	No ramps	No boat ramps	1

Once a score was calculated for each lake, the ratings were divided into low, moderate, and high sensitivity to development. A higher score indicates a higher sensitivity to development. Highly sensitive lakes are less suitable for new development, impervious surfaces, roads, or some types of recreation due to their size, shoreline type, morphology, and accessibility for recreation.

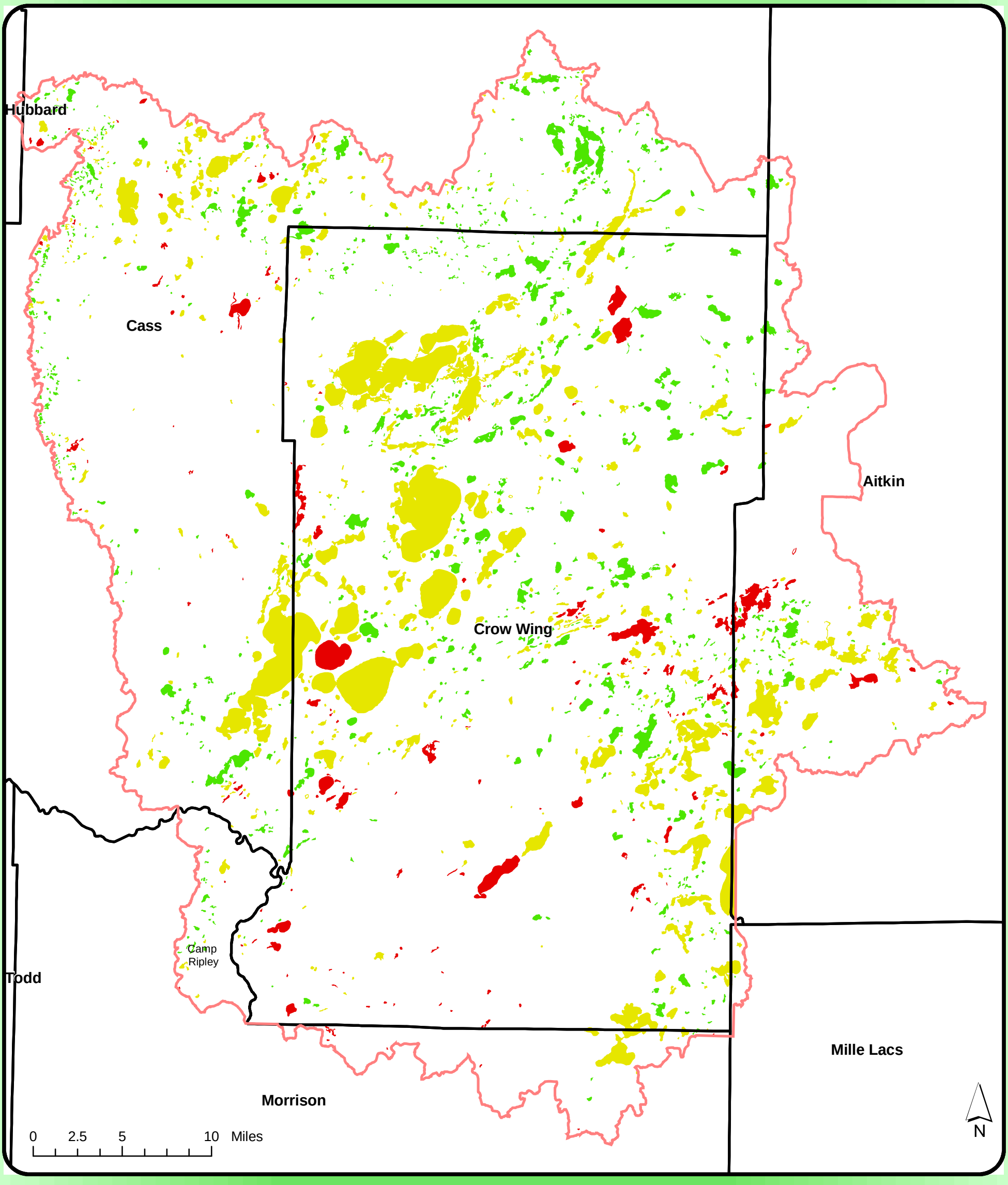
Given adequate data, the sensitivity score should include more types of data. Comprehensive data on maximum lake depth could be useful in informing us about the ratio of depth to surface area of a lake to provide clues as to the ability of a lake to absorb pollutants. Information on flushing rates for lakes, that is, the residency time of water in a particular lake, could be used to calculate the nutrient budget of that lake. Comprehensive soils data could be used to examine erosion or development potential, especially if factors such as slope, stability, and wetness can be calculated for riparian areas.

Lake Viability

Three comprehensive data layers were used to calculate viability scores for each lake within the BLACC study area (Map 7D, Table 6). Natural land cover within a lake's watershed plays an important role in maintaining a natural hydrologic regime and providing habitat for terrestrial and semi-aquatic species of concern. Native cover classes include all native terrestrial vegetation classes, emergent and woody wetland vegetation, open water, and bare rock. Conversion of the riparian zone disrupts natural hydrologic flow patterns, destroys habitat for semi-terrestrial and shoreline species, and degrades buffering capacity, leading to the excess nutrification of near shore waters. Converted land cover classes include all residential, commercial, or industrial development classes, non-native vegetation classes, row crop, pasture, and small grain agriculture, as well as residential recreation (e.g., golf courses). Finally, for reasons outlined

Map 7D - Lake Viability for Protection

Brainerd Lakes Area Conservation Collaborative



Viability for Protection

- High
- Moderate
- Low

Lower is Better

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Map compiled by: James Lehnhoff

above, the presence of invasive species can severely influence the long-term viability of a natural lake ecosystem.

Table 6 - Lake Viability for Protection

Attribute	Classes	Description	Score
Percent Natural Cover (watershed)	91% - 100%	Very Good	4
	81% - 90%	Good	3
	33% - 80%	Fair	2
	0% - 32%	Poor	1
Percent Riparian Conversion (150m buffer)	91% - 100%	Very Good	4
	81% - 90%	Good	3
	51% - 80%	Fair	2
	0% - 50%	Poor	1
Presence of Exotic Species	0	No exotics	3
	1	One exotic	2
	>1	Multiple exotics	1

Similar to the lake sensitivity analysis, the viability analysis assigns a score to each attribute to create a viability for protection rating. A higher rating indicates a greater potential for successful protection.

There are several layers of information that would create a more robust measure of lake viability. There is a good deal of this information that exists, but again, most is relatively useless for this effort due to the lack of comprehensive coverage for the BLACC study area. Some comprehensive measure of trophic status (the reproductive level of a given lake that ranges from clear, high oxygen, low nutrient lakes to murky, low oxygen, high nutrient lakes) would be especially helpful in monitoring the eutrophication rates of lakes over time. When eutrophication, the changing of trophic status, is unnaturally accelerated rates by anthropogenic (human-created) pollutants, the composition of native communities can be radically altered. Additionally, knowledge about the full diversity of native aquatic plant and animal communities across the region would help in gauging both lake sensitivity and viability. Natural communities with higher diversity tend to be less prone to the establishment of invasive exotic species and are, therefore, more viable over time. Finally, direct measures of shoreline development (e.g. housing and resort densities) could be helpful in establishing the thresholds where riparian conversion begins to negatively affect different lake types.

Potential Priority Conservation Lakes

Priority conservation lakes represent the best example of each lake type based on a number of natural and human-influenced characteristics, as listed below:

- Highest percentage of watershed and/or riparian buffer (150m) in natural cover types.
- Lowest percentage of watershed and/or riparian buffer in converted land use types.
- Highest amount of watershed and/or riparian buffer in public ownership.

- Highest amount of watershed and/or riparian buffer identified as high or moderate biodiversity value by the Minnesota County Biological Survey.
- Presence of species of concern/natural heritage database species.
- Absence of invasive exotics.
- Fewer number of boat ramps.
- Impaired status as assigned by the Minnesota Pollution Control Agency and the United States Environmental Protection Agency.
- Lake sensitivity and viability scores.

The idea behind designating priority lakes was to highlight a single lake of each type that would require the least amount of restoration or acquisition dollars while capturing the most biodiversity value (Map 7E). Highest priority was placed on those lakes with watersheds that exist in the most natural condition. Natural cover within the riparian buffer is especially important in maintaining the proper form and function of the shoreline area, filtering incoming pollutants, and preventing excessive erosion by dissipating wave action. Higher public ownership surrounding a lake provides more leverage to maintain the habitat in a natural state, and allows access for the public to enjoy the resource.

There are several lake types for which there is more than one lake existing in a high quality state. In such cases, greater priority was given to those lakes that harbor species of concern, or that have a large percentage of their riparian area identified as being of high or moderate biodiversity value. The presence of invasive species, multiple boat ramps, or being listed as impaired were all significant negative factors. In the case where all other factors are equal, lakes with lower sensitivity and higher overall viability were chosen.

Priority lakes are the single example of each lake type that represent the best opportunity for conservation, and if all were preserved, would capture the full diversity of lake types across the BLACC study area. However, they do not necessarily account for the full range of variability within lake types. Therefore, an effort should be made to protect a larger percentage of each lake type across the region, perhaps somewhere in the range of ten to thirty percent of each lake type. For many lake types, there exists only a single example, necessitating immediate conservation action to ensure the long-term viability of those unique ecosystems.

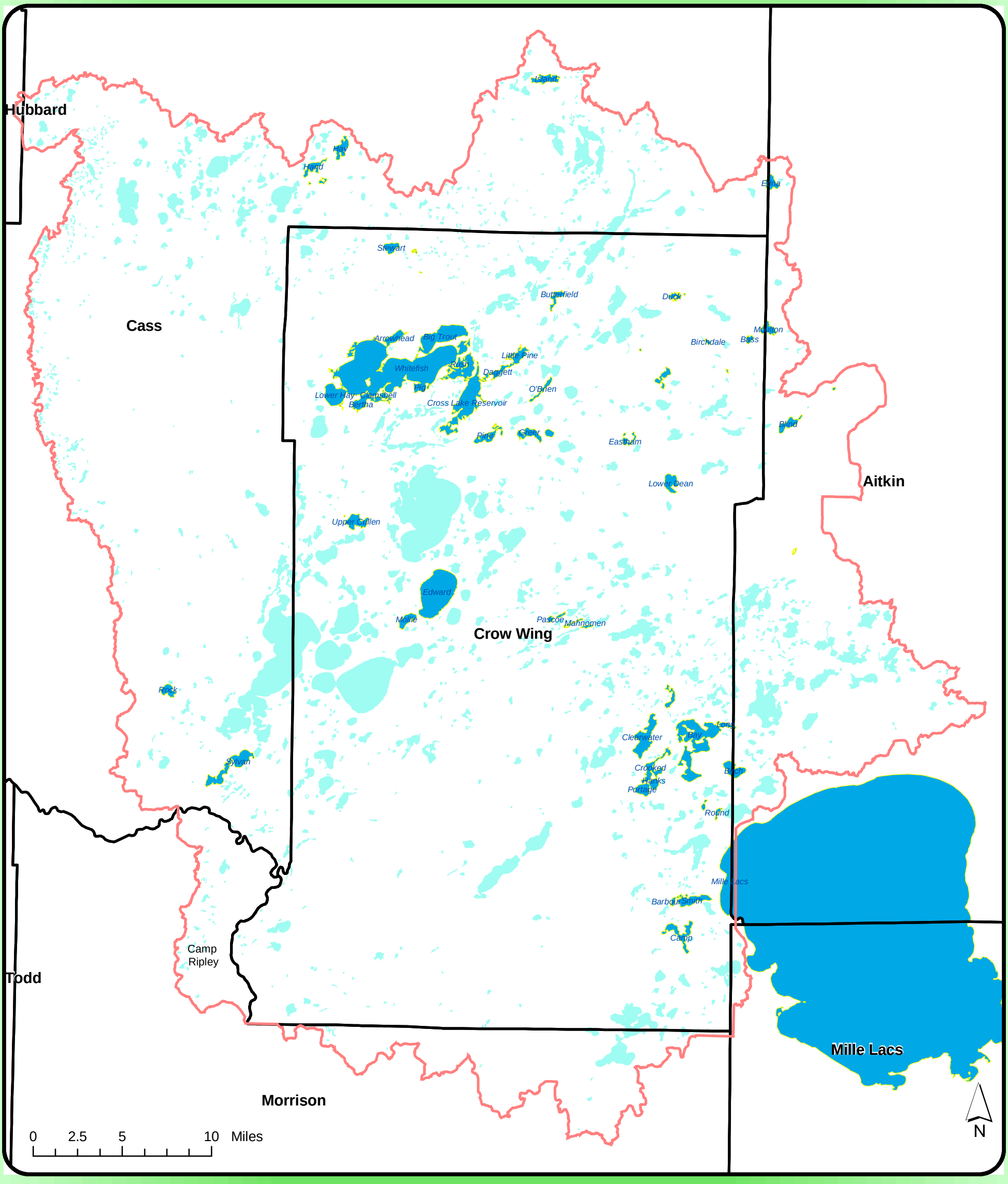
Aquatic, Terrestrial, and Indicator Species Stresses

While there seems to be an abundance of undeveloped and ecologically important lands in the Brainerd Lakes region, development is stressing these areas due to fragmentation that creates smaller areas that are more susceptible to human disturbance. Development can fragment terrestrial habitats and lead to contamination in aquatic habitats. The increasing human population and the subsequent development and roads are an immediate and continuous threat to both habitats.

In addition to development, some types of recreation can create irreparable harm to native plants, rare species, wetlands, and lakes. Motorized types of recreation such as ATVs, motorized boats,

Map 7E - Benchmark Lakes

Brainerd Lakes Area Conservation Collaborative



Benchmark Lakes

Other Lakes

Each benchmark lake represents a unqiue lake of a particular type.

Map created for "Aquatic Resources and Conservation Priorities for the Brainerd Area, Minnesota," by Roy Weitzell. Prepared for The Nature Conservancy and the Brainerd Lakes Area Conservation Collaborative. For a complete description of methodology and citations, please obtain the full document from The Nature Conservancy (unpublished at the time of this map's release).

Adapted for and distributed with "Inventory and Assessment of Natural Resources in Crow Wing County: A Framework for Conservation and Recreation Planning" Brainerd Lakes Area Conservation Collaborative, 2004

Map compiled by: James Lehnhoff

off-highway vehicles, and snowmobiles disrupt high value natural environments and harm wetlands when used in inappropriate environments not able to handle those uses (Map 8A).

Exotic species, dams, and boat accesses also threaten high value aquatic habitats. Exotic species can displace native species and permanently alter the native habitat (Map 8A)[17]. Boat accesses are vehicles for exotic species invasion and can lead to shoreline damage from motorboats[18]. Dams facilitate exotic species invasion by slowing water flows and allowing species to move upstream; however, dams also block some exotic species from moving further upstream[19]. Furthermore, many dams throughout the region are used to regulate water levels in an unnatural pattern. Typically, water levels are higher in the spring and lower in the fall and summer. However, when water levels are regulated, spring water levels are often lowered to control flooding and raised in fall and summer to keep the flow constant. This can strain fish and plant species that require changing water levels for breeding and regeneration.

While feedlots, landfills, and leaky underground storage tanks are detrimental to groundwater, these pollution sources are also harmful to lakes and wetlands, particularly isolated lakes and wetlands (Map 8A)[20]. If feedlot waste or agricultural runoff leaks into a lake or wetland system, the increased pollution can cause an unnatural and accelerated eutrophication, which can lead to algae blooms, low oxygen content, and the eventual death of many species native to the system.

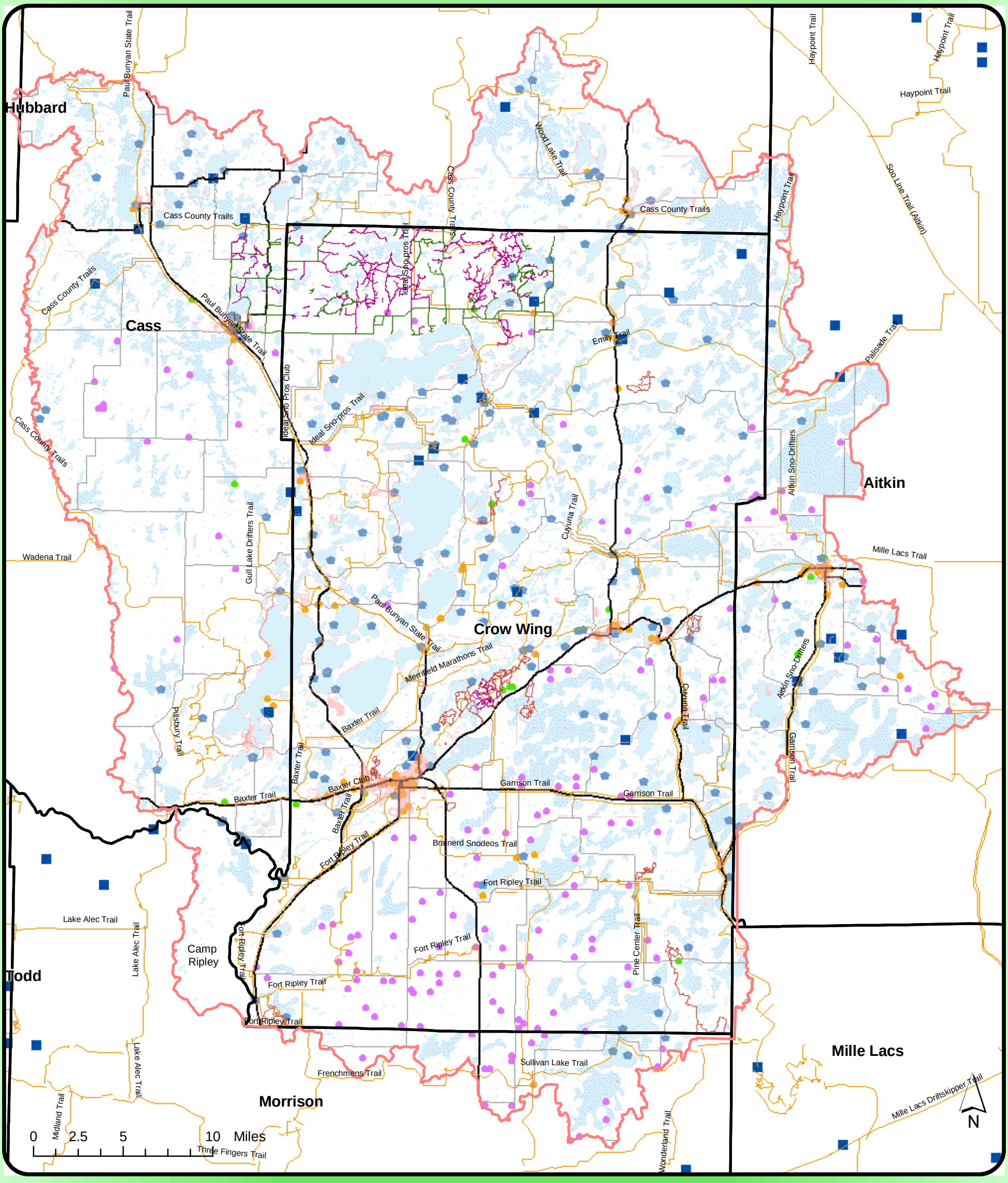
The location of each individual sewage treatment system (ISTS or septic system) was not readily available for the study region, and existing and new developments have the ability to cause great harm to lakes and wetlands if their ISTS leaks waste into the water system. Similar to feedlots and other agricultural uses, non-compliant ISTSs can contribute to unnatural eutrophication in lakes and wetlands, though compliant systems tend to have less of an affect than feedlots and agricultural runoff. Point-source discharges (such as municipal wastewater treatment plants) are also increasingly viewed as a potential source of pollution, even when fully compliant with National Pollution Elimination Discharge System (NPEDS) permit conditions. Because the Mississippi River is classified as an Outstanding Resource Value Water, any increases in point discharges are likely to be subject to increasing regulatory restrictions, including more advanced levels of phosphorus treatment and removal.

Both the Blanding's turtle and the Red-shouldered Hawk face numerous stresses in their ecosystem. The stresses are similar to the stresses faced by other aquatic and terrestrial communities, which includes increasing development on forested lands, habitat fragmentation, and a rapidly growing population (Map 8B). Unfortunately, the primary Blanding's turtle and Red-shouldered Hawk habitats are fragmented by roads and urban development in several locations. Most species, including the Blanding's turtle, require uninterrupted natural settings. The Blanding's turtle is particularly vulnerable to roads with heavy traffic where adult mortality

[17] MN DNR: Invasive Species Program
[18] MN DNR Online Data Deli: Boat Accesses
[19] United States Army Core of Engineers: National Inventory of Dams
[20] Minnesota Pollution Control Agency: Feedlot Program; Leaky Underground Storage Tank Program; Landfill Program

Map 8A - Environmental Stresses

Brainerd Lakes Area Conservation Collaborative



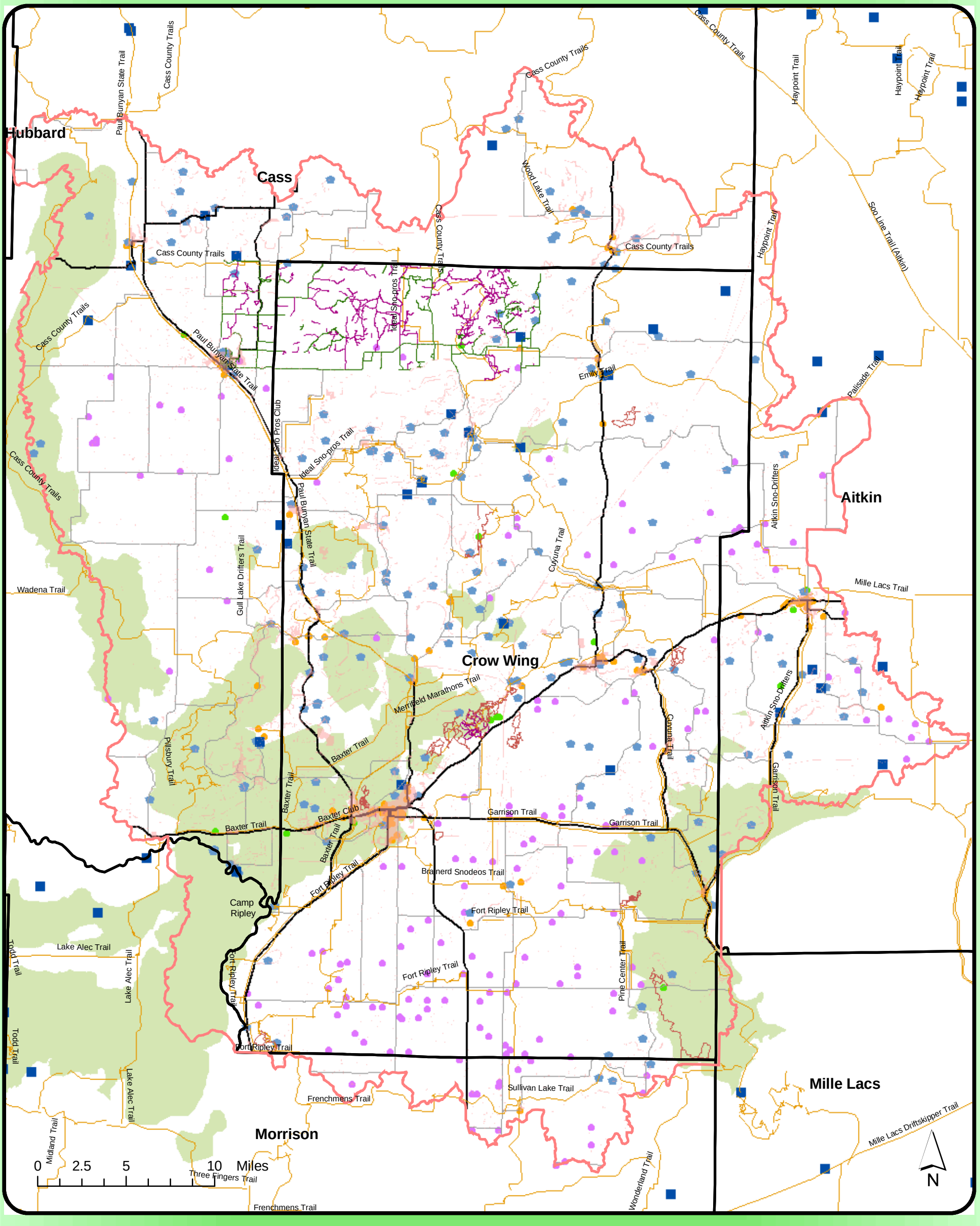
- Impervious Surfaces
- Highways
- Other Roads
- Snowmobile/State Trails
- Motorized
- Non-Motorized
- Undefined
- Dams
- Boat Access
- Leaky Underground Storage Tanks
- Registered Feedlots
- Landfills
- Lakes or Open Water
- Wetland

For distribution with "Inventory and Assessment of Natural Resources in Crow Wing County: A Framework for Conservation and Recreation Planning" Brainerd Lakes Area Conservation Collaborative, 2004

Data sources: MN DNR Online Data Deli, MNDOT, MN PCA, United States Army Corps of Engineers
Compiled by: James Lehnhoff

Map 8B - Indicator Species Stresses

Brainerd Lakes Area Conservation Collaborative



Combined Indicator Species
Highways
Other Roads
Snowmobile/State Trails
Motorized
Non-Motorized
Undefined

Dams
Boat Access
Leaky Underground Storage Tanks
Registered Feedlots
Landfills
Impervious Surfaces

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Data sources: MN DNR Online Data Deli, MNDOT, MN PCA, United States Army Corps of Engineers

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can directly decrease the population. While other stresses certainly exist, the stresses described above are the most immediate and long-term affects these species face. If these species are to survive in their natural habitat, these stresses will have to be remedied.

Terrestrial, Aquatic, and Indicator Species Potential Conservation Areas

High quality lakes, wetlands, and lands are an integral part of the Brainerd lakes region character and economy. However, identifying significant natural resources involves more than just selecting a single lake, animal species, or particular forest area for conservation. Protecting natural habitats involves preserving and managing corridors of interconnected lakes, wetlands, and terrestrial habitats that offer an abundance of biodiversity and unique systems. Aquatic and terrestrial habitats are interdependent and therefore rely on the health of each another.

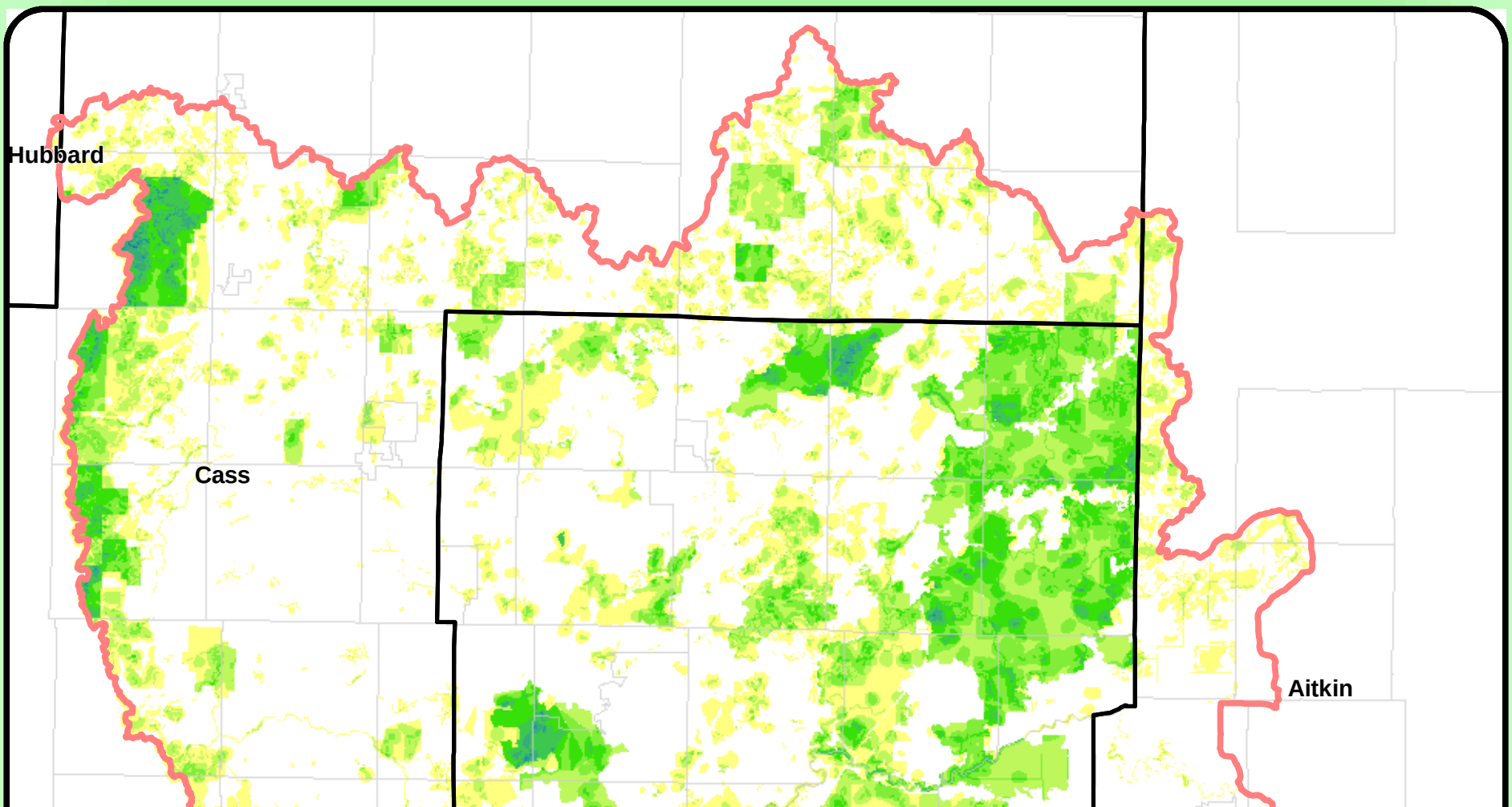
The primary goal of this report is to identify environmental preservation corridors since it is not realistic to suggest protecting the entire study area. Based on the data used in identifying high value terrestrial communities along with the Blanding's turtle and the Red-shouldered Hawk habitat data, potential terrestrial preservation corridors were identified based on overlap within the different data sets (Map 9A). Map 9A, *Potential Conservation Priority Areas*, displays, by varying color intensity, the number of natural feature overlaps based on the data described in the sections above. Those areas with a darker green are theoretically more significant and more sensitive to development and fragmentation. These are areas that should be considered for conservation or non-traditional types of development that do not fragment natural areas with roads and preserves areas of natural vegetation. This is not to say that every place with a natural feature should be conserved from all development; this map simply identifies areas of interest for conservation depending on need and available resources. Since money for conservation and recreation resources is limited, this analysis attempts to identify corridors with the most overlap between unique or significant ecological features. Essentially, the map indicates the density of ecologically significant areas or resources.

Although the potential conservation areas focus on terrestrial habitats, many lakes and wetlands are included in the identified corridors (Map 9B). The aquatics data, described in previous sections, is meant to supplement the terrestrial corridors by informing planners, policy makers, residents, and developers on which individual lakes could be protected or preserved as part of a combined terrestrial and aquatic corridor.

Before the data from the previous sections were combined, a few adjustments were made to compensate for weaknesses in the data. Because habitats rarely end at specific boundaries, as the map would indicate, buffers were placed around several data features to delineate "zones of influence" where the identified important features may extend but the coarseness of the data hides the natural transition. Furthermore, the buffer is a protection zone for the important feature. The Minnesota DNR defines the shoreland zone as the 1000 feet of land from the waterline, and the DNR and local units of government have special development regulatory

Map 9A - Potential Priority Conservation Areas

Brainerd Lakes Area Conservation Collaborative



Potential Conservation Priority

Higher Priority | | | | | | | | | **Lower Priority**

Data Description:
The map was created using the variables listed below:
- County Biological Survey data
- Identified Blanding's Turtle and Red-shouldered Hawk Habitat
- Natural Heritage Database: Rare, threatened, and native species concentration
- Isolated lakes and a 1000 foot buffer
- Wildlife Lakes and a 1000 foot buffer
- Opportunity Lakes and a 1000 foot buffer
- High value forest areas and 1000 foot buffer
- High value riparian habitat and a 300 foot buffer
- Other riparian habitats and a 150 foot buffer

Except for the County Biological Survey data, each variable was combined to calculate and display the number of overlaps among the variables to indicate areas of potentially high conservation priority due to diverse, unique, or high value features. The County Biological Survey data was weighted according to the biological significance assigned by the surveyors. Full methodology is available in the "Conservation Plan for the Brainerd Lakes Area" report from the Brainerd Lakes Area Conservation Collaborative.

Data Sources:
MN DNR Online Data Deli
Minnesota County Biological Survey
Minnesota Natural Heritage Database
MNDOT
National Hydrography Dataset

Compiled by: James Lehnhoff

Although the potential conservation areas are meant to guide development, this data should not be used for site specific planning.

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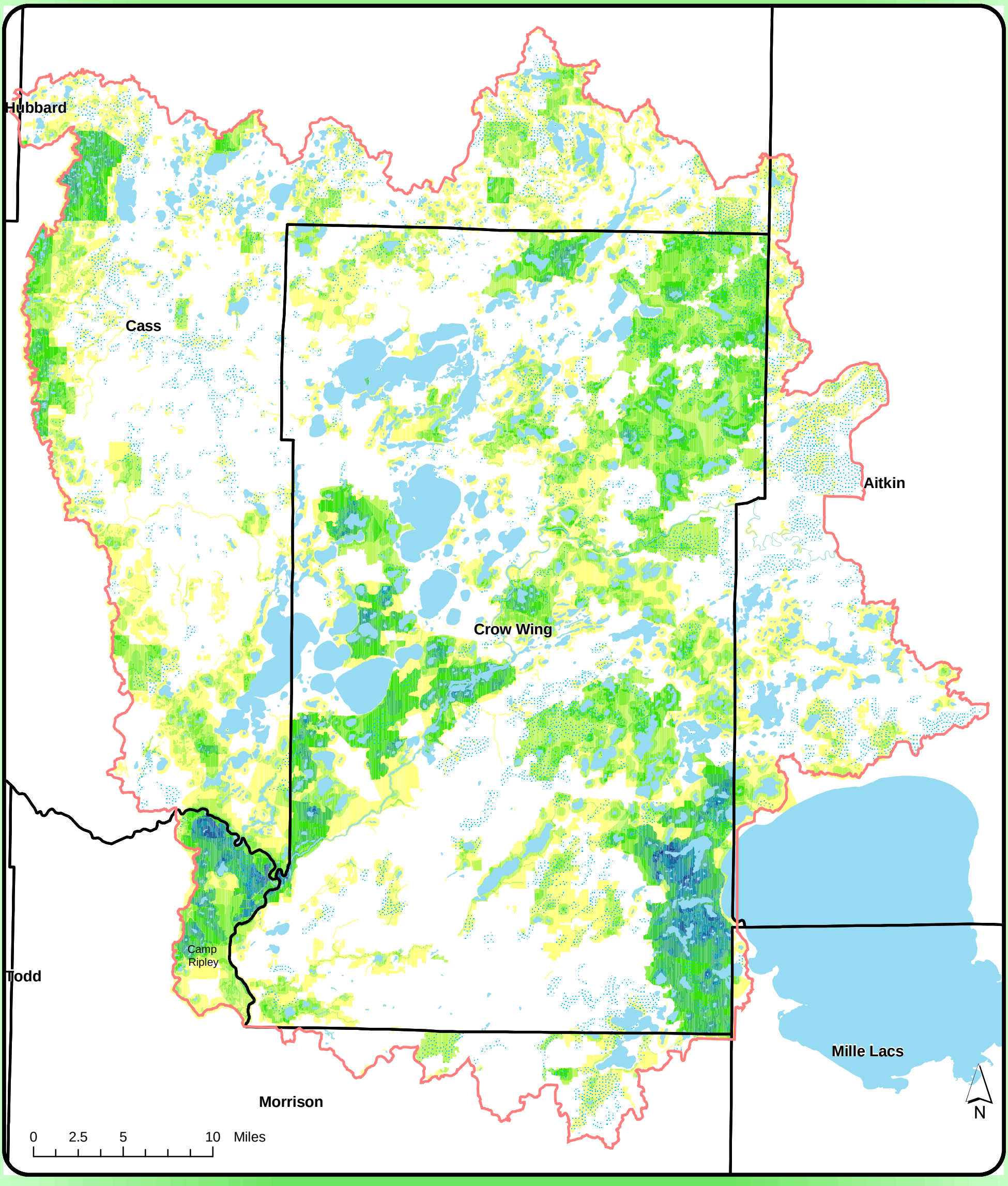
Map 9B - Potential Conservation Areas, Lakes & Wetlands

Brainerd Lakes Area Conservation Collaborative



Potential Conservation Priority

Higher Priority | | | | | | | | | **Lower Priority**

Lakes or Open Water

Wetland

Data sources:
MN DNR Online Data Deli
MN PCA, MNDOT
Crow Wing County
United States Corps of Engineers
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powers in this zone[21]. Opportunity lakes, Wildlife lakes, and isolated waterways were given a 1000-foot protection buffer for this analysis. River and stream habitats also require undisturbed shorelines and were given a 300-foot buffer around rivers and streams to preserve remaining natural, publicly owned lands and to connect to other aquatic habitats. The Minnesota DNR also has some regulatory power within 300 feet of a stream depending on stream type[22].

In addition to the aquatic buffers, a 1000 foot buffer was also placed around the potential high value forest areas and the possible high value forests areas to cover transitions and potential pre-settlement forest stands that exist outside the hard boundaries on the maps. The county biological survey and natural data do not require buffers because the data has built in transitions.

The various data sets and their associated buffers were merged to identify the potential conservation priority areas (Map 9A).

Terrestrial, Aquatic, and Indicator Species Conservation Recommendations

Since half of the study area is still forested and another quarter is water, it is not difficult to identify terrestrial and aquatic corridors. Furthermore, stretches of priority areas, forestlands, and open water are within public ownership, which makes conservation in these areas less challenging. Still, much of the study area exists outside of the public domain, for which, strategies have been developed to protect the higher value potential conservation areas by limiting or reducing stresses. These strategies include limiting the number of additional roads, creating zoning and development incentives that guide or transfer development rights to other parts of the region that are less sensitive to development, and creating incentives that reduce fragmentation such as cluster developments (Map 9C).

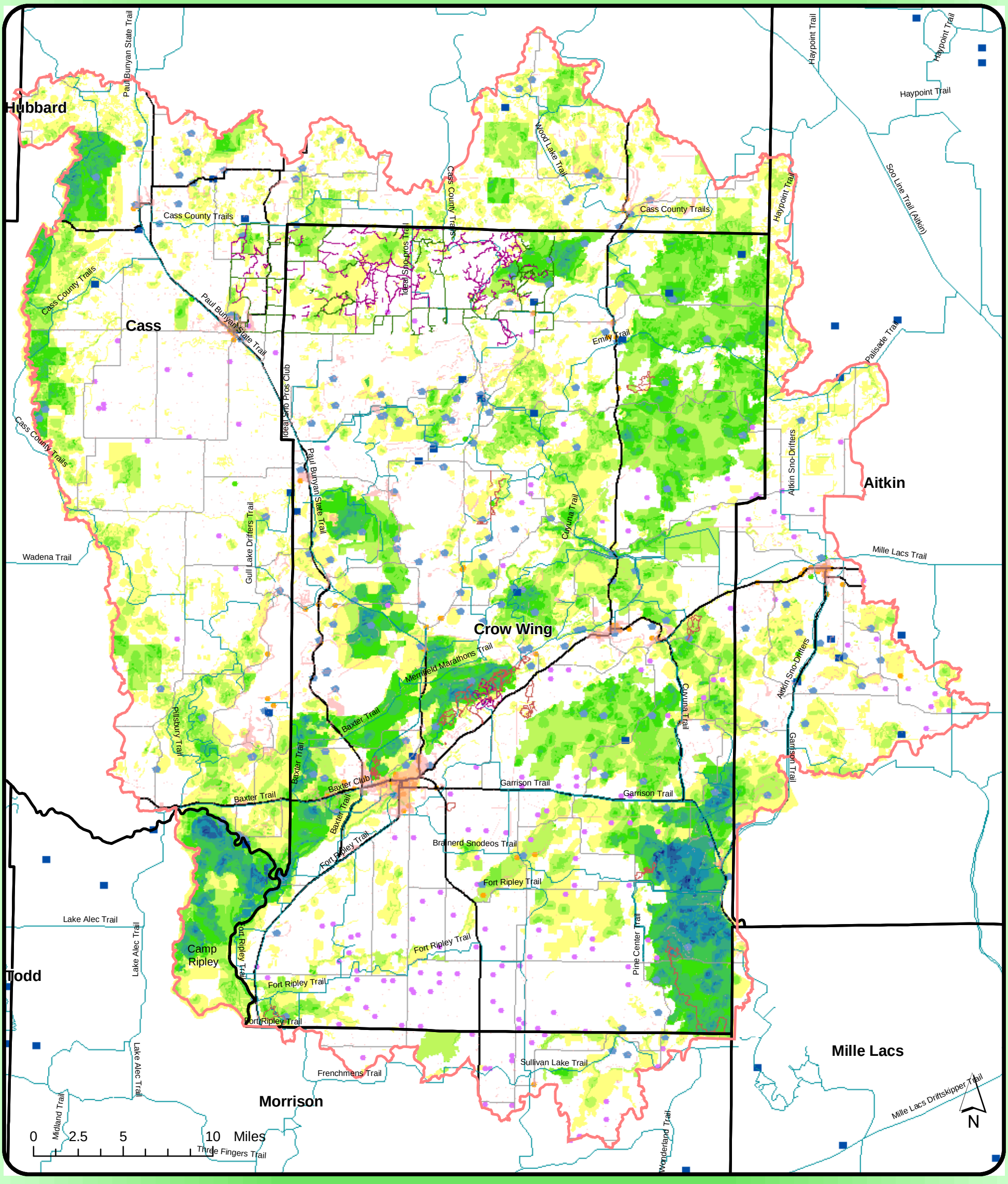
The high growth corridor between Brainerd and Baxter is one of the locations most sensitive to development due to its concentration of significant, though fragmented, natural features. Although this area is split by several major highways and growing urban developments, the demand for undisturbed open spaces is growing. The lack of public land in this corridor will likely make it difficult to create any large corridors; however, small patches of significant features could be protected and could serve as a "stepping stone" to link larger patches of habitat outside the corridor.

Camp Ripley, located in the southwestern portion of the study area, appears to have significant overlap between a variety of natural features that might make it a prime target for conservation since it is already under public ownership. Camp Ripley is federally owned and does not have any major crossroads running through it, but it does host some military activities that have the potential to impair natural systems. However, the wide swatch of public land, few road crossings, and the current plan to create a buffer of no development around the camp make it possible to include this area into a larger conservation corridor[23].

[21] Minnesota Department of Natural Resources: *Statewide Shoreland Management Standards*
[22] Ibid.
[23] Camp Ripley buffer plan: http://nature.org/wherewework/northamerica/states/minnesota/press/press1324.html

Map 9C - Potential Conservation Area Stresses

Brainerd Lakes Area Conservation Collaborative



Potential Conservation Priority

- Higher Priority
- |
- |
- |
- |
- |
- |
- |
- Lower Priority

- Impervious Surfaces
- Highways
- Other Roads
- Snowmobile/State Trails
- Motorized
- Non-Motorized
- Undefined

- Dams
- Boat Access
- Leaky Underground Storage Tanks
- Registered Feedlots
- Landfills

Data sources:
MN DNR Online Data Deli
MN PCA, MNDOT
Crow Wing County
United States Corps of Engineers
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The northeastern portion of Crow Wing County has a high concentration of natural features, indicated by the County Biological Survey data that identifies this area as an area with high biodiversity importance. The tracts of public land and the relative lack of development make this a potentially important area for conservation. However, like many other parts of the study region, this area is growing fast and private lands may fragment the natural environment with additional roads and sprawled development.

While the Mille Lacs region in the southeastern portion of the study area has an abundance of natural features and has an outstanding rating for biodiversity from the County Biological Survey, the lack of public lands and the pressure to build in this area might make it difficult to create a broad conservation corridor. This region may require more creative developments and an emphasis on connecting remaining green corridors on private lands to protect the significant natural resources in this portion of Crow Wing County.

In order to protect all aquatic habitats from invasive exotic species, existing regulations, such as removing aquatic plants from boat trailers and removing exotic species from water systems, will need to be enforced since there is little that land-use regulations can do to restrict exotic species from spreading (Map 9C).

Specific conservation recommendations will need to be developed in cooperation with local governments, local land owners, and other stakeholders to ensure that local and regional conservation demands are met along with larger state needs. While potential conservation areas can be identified, actual conservation will only occur when money is available for conservation, the lands to be conserved are available for purchase, and demand exists for conservation or open space.

Recreation and Open Space

Passive and active recreational opportunities, along with uninterrupted open space for humans and wildlife, help provide a high quality of life for both existing and future residents, tourists, plants, and animals in the Brainerd Lakes region. This section identifies existing recreational resources and open spaces, discusses current stresses on those resources, and offers basic recommendations to expand recreational opportunities and preserve open spaces. Due to limited data availability outside Crow Wing County, reviews of existing and potential recreational opportunities focus primarily on Crow Wing County.

Although recreational data is somewhat incomplete for Crow Wing County, there are surprisingly few managed public recreational opportunities despite the abundance of lakes and large tracts of publicly owned land (Map 3 & 4). Existing public recreational opportunities in Crow Wing County and the rest of the study region include public beaches, city parks, county parks, state parks, boat accesses, water activities, campgrounds, trails, scenic amenities, and historic sites.

There are two types of recreational activities, passive and active recreation. Passive recreation involves non-motorized types of recreation including hiking trails, bird watching, and some water activities. Active recreation involves many team sports and motorized types of recreation, such as all-terrain vehicle (ATV) trails, snowmobile trails, other off-highway vehicles (OHV), and motorized boats. While these two types of recreation are not always spatially compatible – meaning that few people wish to hike while being passed by ATVs – they are both important types of recreation that should be provided.

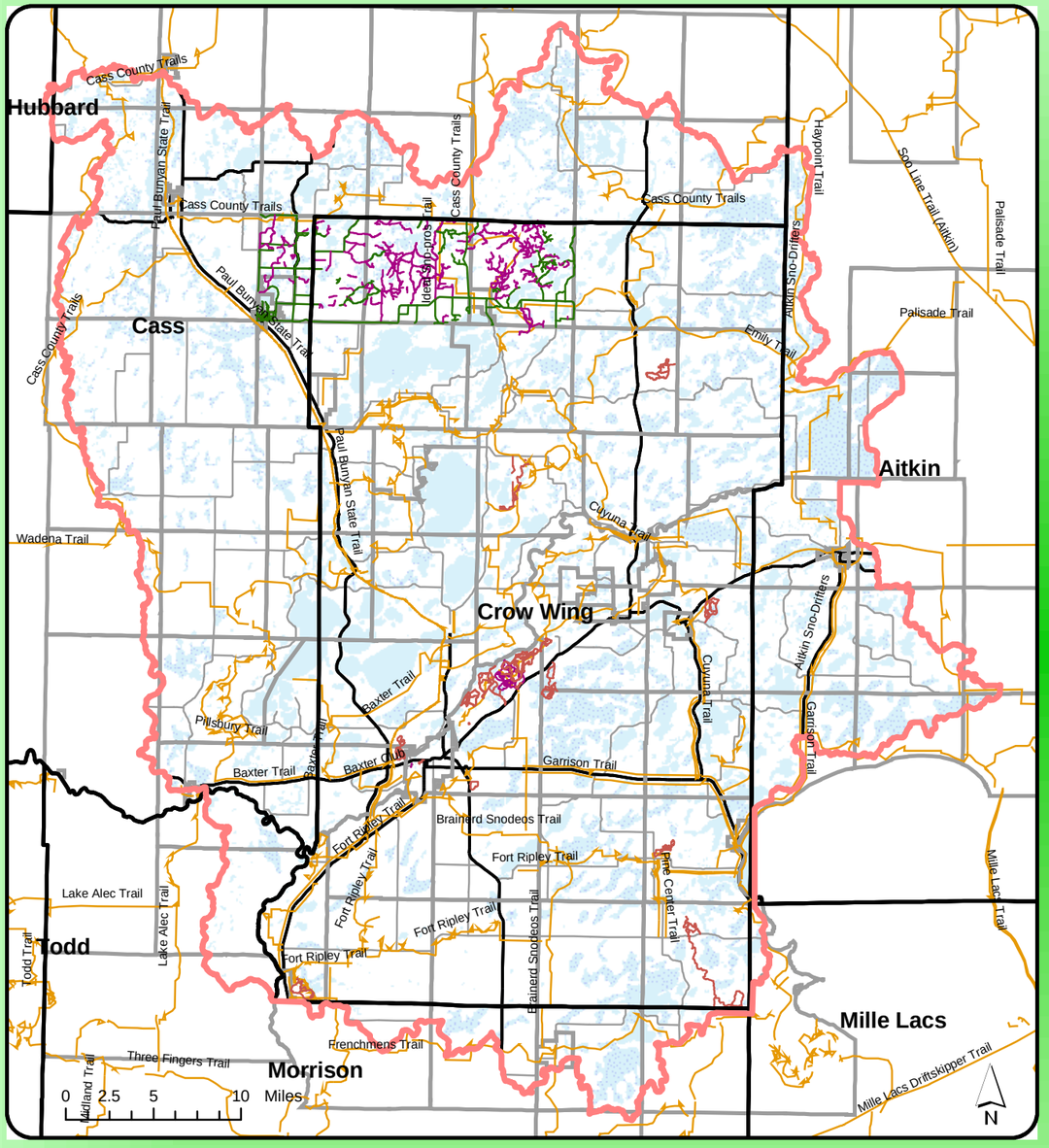
Although not all trails are mapped in Crow Wing County or the study region, Crow Wing County does offer a variety of trails for snowmobiling, all-terrain vehicles, and hiking (Map 10A)[24]. A larger system of snowmobile trails, which are also used for non-motorized uses such as hiking, stretch across the study region and connect to other regional and state trail systems, notably the Paul Bunyan trail. A mix of mapped motorized, non-motorized, and undefined trails are located primarily in the northern parts of the study region in Gail Lake Township, Timothy Township, and the city of Fifty Lakes as well as in Crow Wing and Cuyuna State Parks in the central portion of the study region. Other small trail systems exist in Fairfield Township, Roosevelt Township, West Crow Wing Unorganized, Deerwood Township, and Mission Township. In addition to these off road trails, many people also use roads and highways to hike, bike, and snowmobile.

Although the data is not comprehensive, there are several city parks and public campgrounds spread throughout Crow Wing County (Map 10B)[25]. The city parks tend to be small areas and

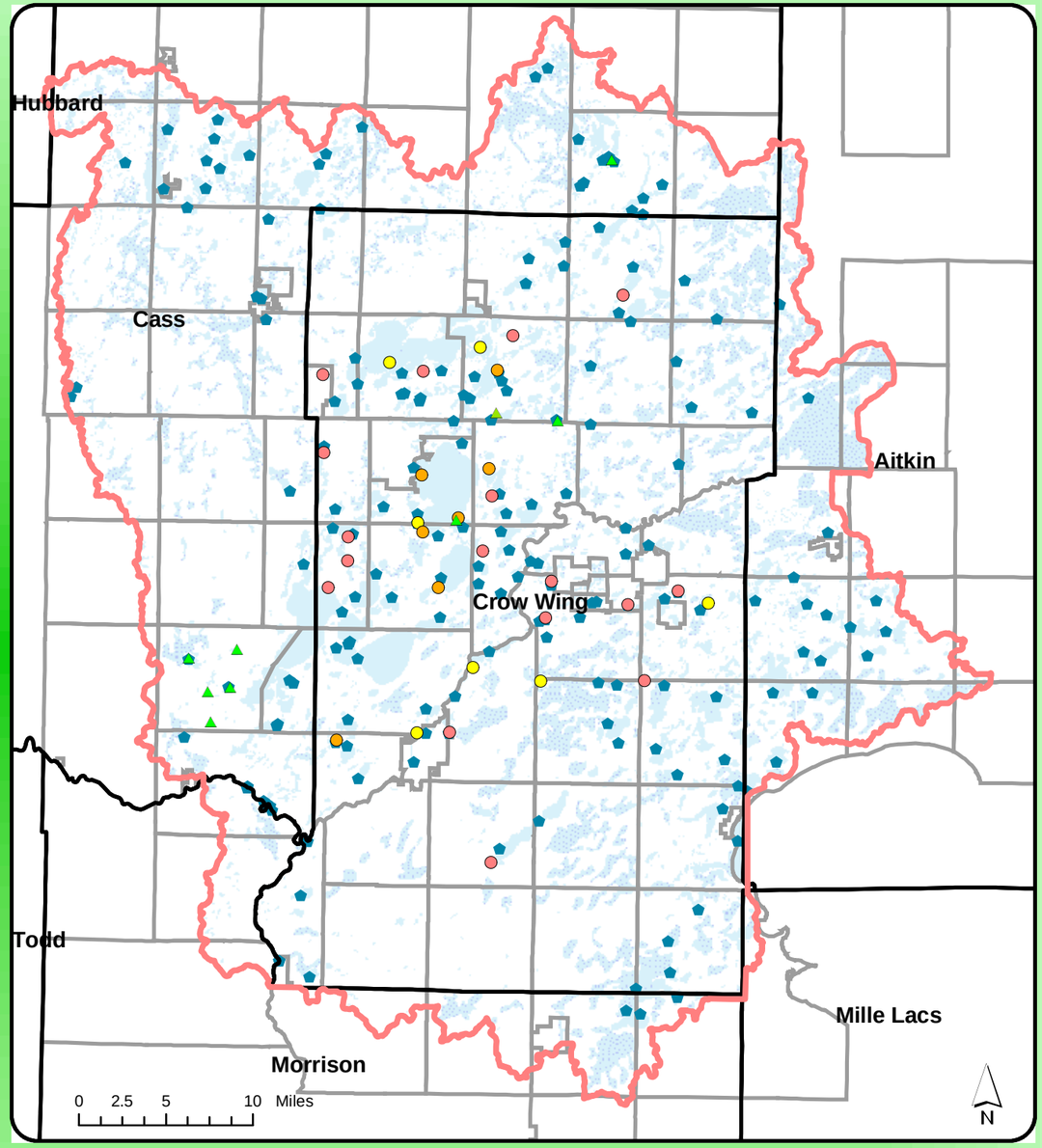
[24] Crow Wing County Parks Department & DNR Online Data Deli: Minnesota Snowmobile Trails
[25] Crow Wing County Parks Department

Brainerd Lakes Area Conservation Collaborative

10A - Trails



10B - Other Recreational Activities



- Snowmobile/State Trails
- Motorized Trails
- Non-Motorized Trails
- Undefined Trails
- Highways
- Other Roads

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Data sources: MN DNR Online Data Deli
Crow Wing County Parks Department, MNDOT
Compiled by: James Lehnhoff

- City Park
- Public Beach
- Other Recreational Area
- Campgrounds
- Boat Access

not meant for active recreational activities that require larger spaces and buffers from residential development. The campgrounds, while important for the local economy and tourists, are not likely to be widely used by existing residents.

The National Guard manages Camp Ripley in the southwestern portion of the study area (Map 3). While Camp Ripley is off-limits to many types of development and public access, it does provide a unique tract of undeveloped land for open space and wildlife purposes, though some of the land is used for military activities. Although not all of the lands in the parks, forests, or Wildlife Management Areas are publicly owned or available for recreational purposes, each of these publicly managed areas offer some opportunity for citizens to recreate or simply enjoy the relatively undisturbed open space.

According to the Minnesota Department of Natural Resources, there are 181 publicly managed boat accesses within the study region (Map 10B)[26]. While a few of these boat accesses are carry-in locations, most are designed for trailer access. According to the Crow Wing County Park Department, there are only six publicly managed beaches in the county; a surprisingly small number given the growing population and large number of lakes in the county.

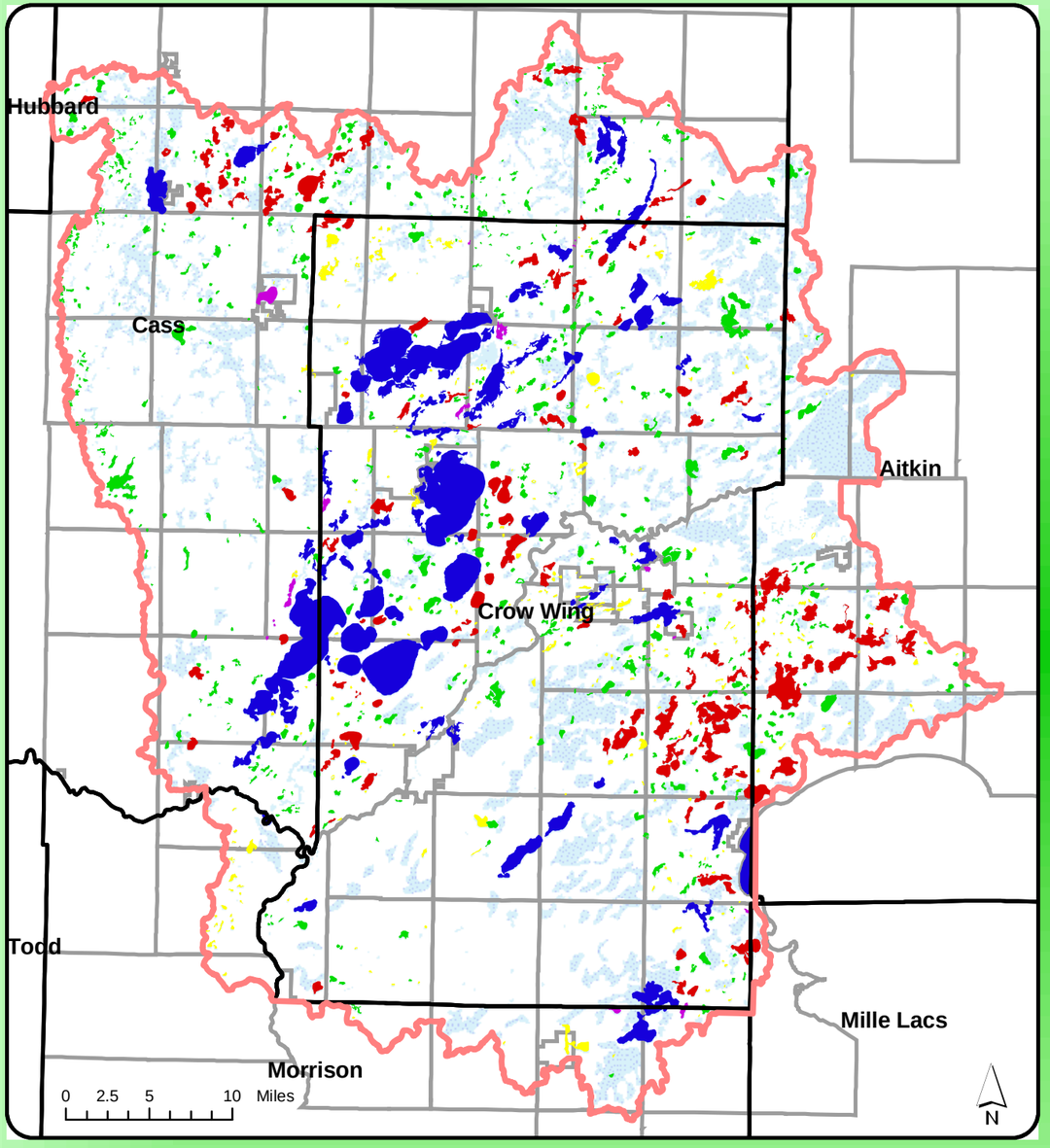
While boat accesses and beaches are important public access points for recreation, it is difficult to ignore the value of the vast stretches of open water and wetlands as a significant open space resource. Open water and wetlands cover more than 25 percent of the study region and are important for humans and wildlife alike (Map 2A)[27]. Lakes and wetlands, however, are not all the same. Some types of open water are more compatible with active or passive recreation uses while others are more suited to open space preservation. The Minnesota Department of Natural Resources classifies lakes as general development, recreational development, or natural environment (Map 10C, Appendix C)[28]. General and recreational development lakes are generally better suited for development and active or passive recreational uses while natural environment lakes are typically not well-suited for recreational or development uses due to lake and shoreline type.

The Brainerd Lakes Region is well known for its many lakes and beautiful scenery. Although the larger lakes are quickly losing natural shorelines, the remaining forests, hills, lakes, and wetlands provide for a number of unique scenic areas (Map 10D)[29]. While each person may have a slightly different interpretation of what is "scenically attractive," this analysis identified scenic locations based on the terrain type, proximity to water, and land cover. Therefore, areas that are near water, have a variety of land cover, and have a rough terrain are considered more scenic than flat, manicured terrain.

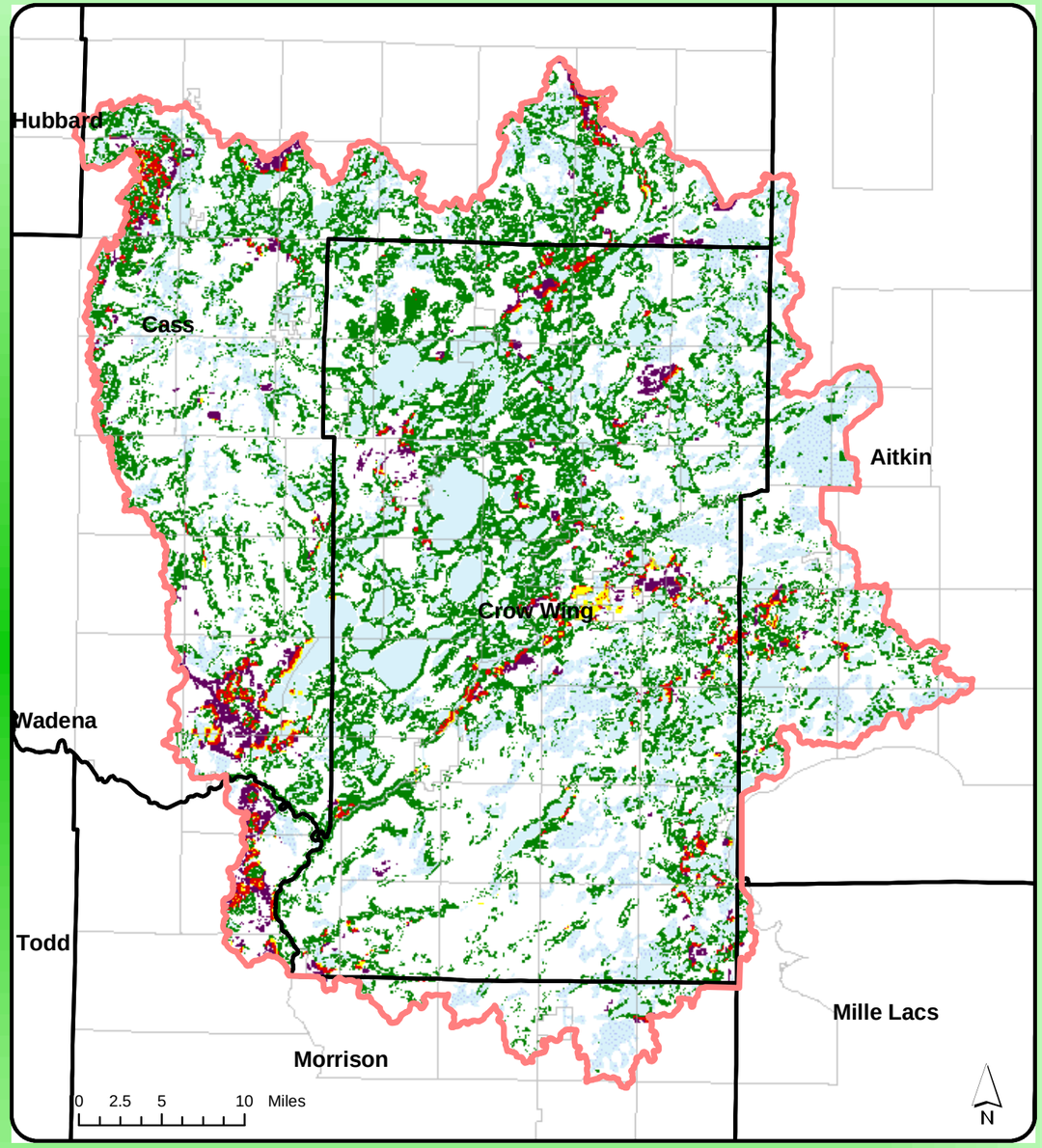
[26] DNR Online Data Deli: Water Access Sites
[27] DNR Online Data Deli: LandSat Based Land Use/Land Cover (Vector)
[28] DNR Division of Lakes, http://www.dnr.state.mn.us/shorelandmgmt/guide/classification.html
[29] Borchert Map Library: Scenic Amenities

Brainerd Lakes Area Conservation Collaborative

10C - DNR Lake Classifications



10D - Scenic Amenities



- Natural Environment
- Recreational Development
- General Development
- Multiple
- Not in Shoreland Program

Natural Environment Lakes usually have less than 150 total acres, less than 60 acres per mile of shoreline, and less than three dwellings per mile of shoreline. They tend to be shallow, swampy, and less than 15 feet deep.

Recreational Development Lakes usually have between 60 and 225 acres of water per mile of shoreline, between 3 and 25 dwellings per mile of shoreline, and are more than 15 feet deep.

General Development Lakes usually have more than 225 acres of water per mile of shoreline and 25 dwellings per mile of shoreline, and are more than 15 feet deep.
http://www.dnr.state.mn.us/shorelandmgmt/guide/classification.html

Scenic Land Cover

- Forested, Rough
- Near water, Forested, Flat
- Near water, Non-forested, Rough
- Near water, Forested, Rough

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Brainerd Lakes Area Conservation Collaborative, 2004
Data sources: MN DNR Online Data Deli
Borchert Map Library, MNDOT
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Stress and Barriers to Recreation and Open Space

The primary stress on both recreational opportunities and open space resources is the increasing population and subsequent residential, resort conversion, commercial, industrial, and road development (Map 2B). Population growth increases the demand for recreational opportunities and open space but can ultimately fragment and reduce access to open land and water for those uses. However, roads are required to access many recreation areas because most publicly owned open spaces are situated away from population centers (Map 11A).

Development along the lakeshore reduces access to the publicly owned lake resources and can be detrimental to lake quality. Much of the population growth in absolute terms is taking place in the southern portion of the study region away from the abundant public lands toward the north that could host recreational activities without having to purchase land from private owners (Map 2B).

As just mentioned, there is an abundance of relatively undisturbed public land north of the major population centers that are not readily accessible by foot or bicycle to most of the region's population. Many of the public beaches, trails, and much of the public lands are also several miles from the Brainerd/Baxter population center (Map 11A). Except for the restricted lands around Camp Ripley, the southern portion of the study region lacks recreational opportunities and large tracts of public land to expand these resources (Map 11B).

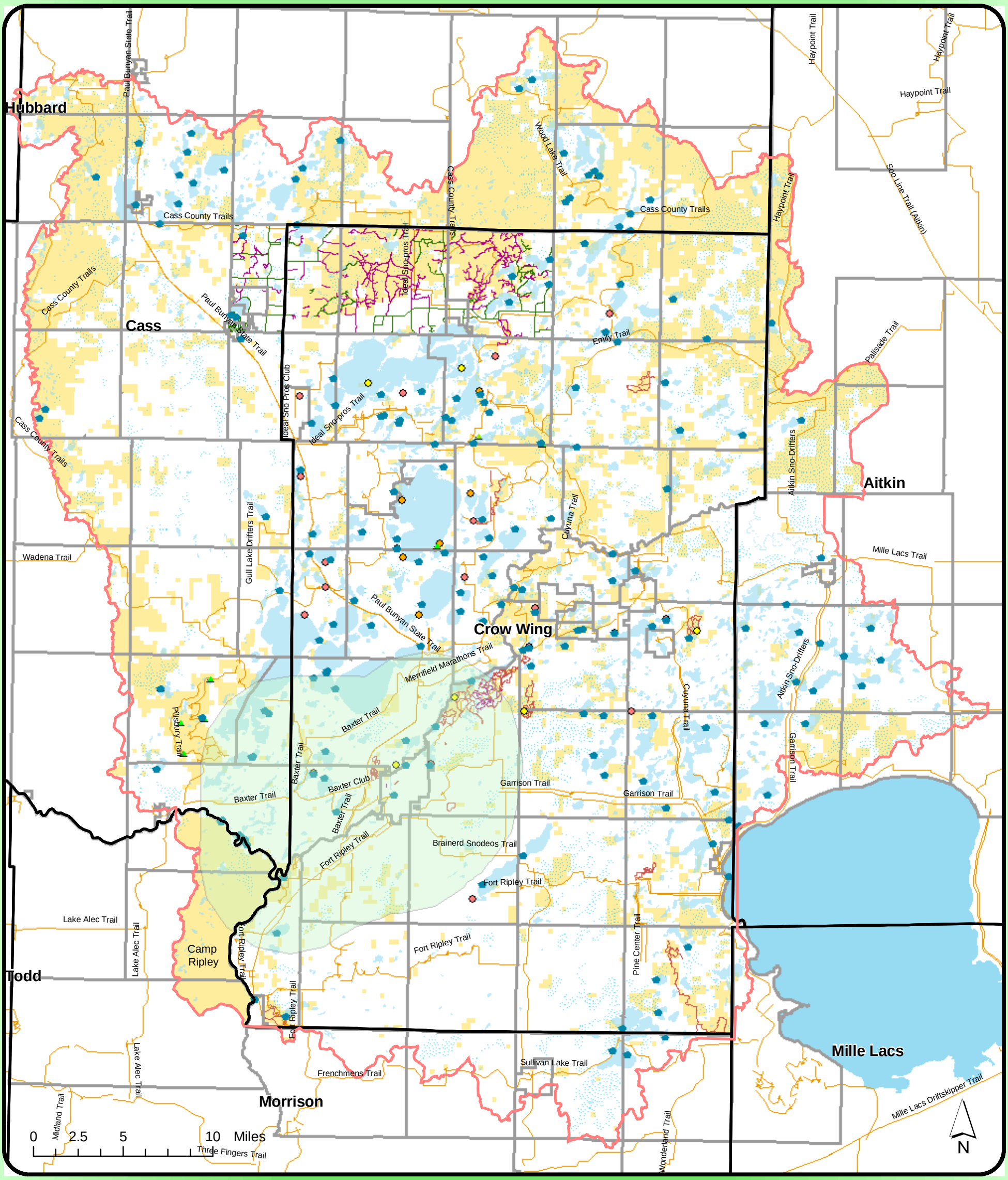
A growing interest and demand for off-highway vehicles, ATVs, and snowmobiles has created a conflict between active and passive recreation users. The trails conflict centers on whether certain public lands should be used exclusively for motorized or non-motorized uses, and what land or habitat types are less affected by sustained motorized use. Certain sensitive habitats and unique scenic areas may not be suitable for motorized use while other areas are (Map 9A & 10D). Furthermore, motorized trails can also come into conflict with residential developments due to noise and pollution.

Potential Recreation and Open Space Opportunities

While a portion of the over 2200 lakes in the study region are popular for recreational purposes or development, many of the lakes, particularly the more remote and smaller lakes, are more suited for open space protection, passive recreation, and wildlife preservation. The Lake Use analysis described in the High Value Terrestrial Analysis section classified lakes into three use categories, Active Use, Opportunity, and Wildlife/Natural Environment lakes (Map 5D). To recap, Active Use lakes are already used by active recreational users and have considerable development along the shorelines. Wildlife lakes tend to be more suited for passive recreation due to their terrestrial habitat value and connection to public lands. Opportunity lakes are open for passive recreation, active recreation, development, or no human use depending on demand, location, and lake type.

Map 11A - Recreational Resources & Population Center

Brainerd Lakes Area Conservation Collaborative



Boat Access

City Park

Public Beach

Other Recreational Area

Campgrounds

Snowmobile/State Trails

Motorized Trails

Non-Motorized Trails

Undefined Trails

Public Land

Brainerd/Baxter 5 Mile Buffer

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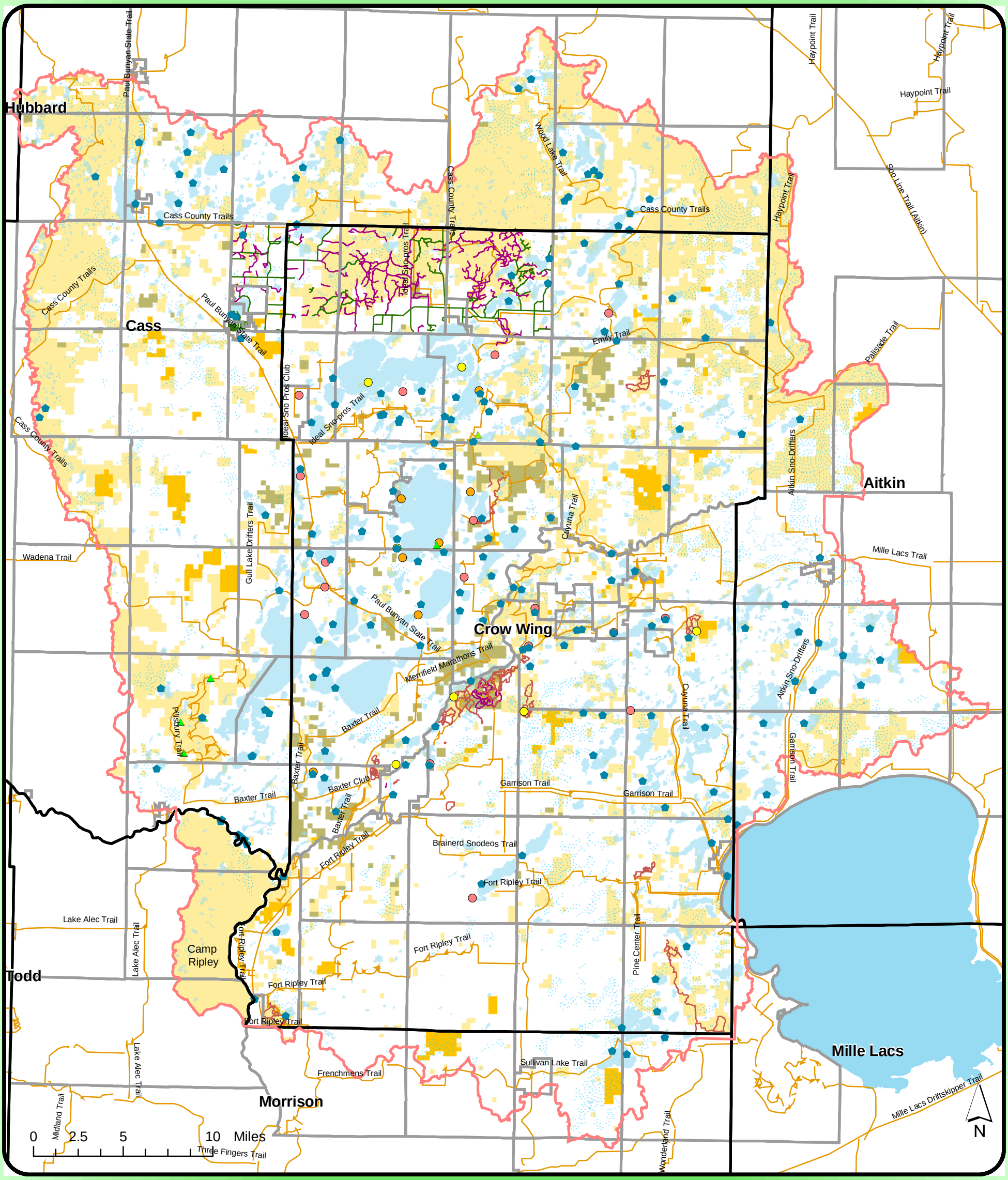
Data source:
MN DNR Online Data Deli
MNDOT
Crow Wing County

Compiled by: James Lehnhoff

Map 11B - Recreational Resources & Public Land

Brainerd Lakes Area Conservation Collaborative



- City Park
- Public Beach
- Other Recreational Area
- Other Campgrounds
- Campgrounds
- Boat Access
- Public Land
- Large Private Holdings
- Potlatch

Data source:
MN DNR Online Data Deli
MNDOT
Crow Wing County

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Compiled by: James Lehnhoff

Since high-quality scenic amenities are particularly reliant on undisturbed land cover, these areas are generally more suitable for passive recreation. This is not to say that ATV users should only use their vehicles in less attractive areas or that all ATV users destroy scenic areas. Once the unique scenic areas are identified, however, it will be easier to find a balance between the motorized and non-motorized areas. Much of the identified scenic lands are already located on publicly owned land in the western and central portions of the study region (Map 11B). These highly scenic locations could be kept within public ownership and connected by non-motorized trails and parks to be used for passive recreation purposes. Wildlife lakes and DNR Wildlife Management Areas could also be connected to the passive recreation and open space system. Active Use or Opportunity lakes should be evaluated on a case by case basis depending on the amount of public land surrounding the lake, the demand for new development, the potential for the lake to serve active recreational needs (Map 11B).

Without a complete map of the trail system, it is difficult to assign specific areas to motorized and non-motorized trail development. While non-motorized trails can coexist with many existing natural areas, motorized trails can cause significantly more impact on the environment when driven in inappropriate areas that are less resistant to motorized traffic. Although most off-highway vehicle users respect the environment, public motorized trails would generally have less of an impact in areas situated away from most high-quality wetlands, highly scenic areas, small public land holdings, high soil erosion potential areas, and concentrated in certain areas to reduce their environmental impact and their impact on residential developments. However, it is also important that both motorized and non-motorized trails be accessible to the public. The existing motorized trail system in Fifty Lakes, Timothy Township, Gail Lake Township, and Barclay Township should be considered for further or more dedicated motorized trail development because of its proximity to major transportation routes, situation on public land, sparse scenic amenities, few wetlands and lakes, and existing trails (Map 11B & 11C). Several motorized trails also exist in Oak Lawn Township, which is adjacent to Brainerd and provides limited motorized activities closer to the major urban centers. In order to site any new trail system, the county should work toward identifying all existing trails.

Motorized trails may be possible in the southern portion of the study region in Daggett Brook and Platte Lake Township due to the relative scarcity of lakes and wetlands and because of its proximity to Brainerd and Baxter. Unfortunately, there is very little public land in these two townships. If other locations are considered for motorized trail use, potential priority conservations areas (Map 9) should be avoided or limited to inhibit environmental degradation.

Non-motorized trails are often used for walking and hiking, which makes these types of trails less harmful to the surrounding environment. However, since these trails are non-motorized, it is more important to have non-motorized trail options close to population centers to make them easily accessible (Map 11A). In fact, accessibility is one of the most immediate problems for expanding recreational lands for passive or active recreation. Public lands adjacent to roads and closer to urban centers are particularly important for recreational purposes because of their

Map 11C - Recreational Resources & Potential Conservation Priority Areas

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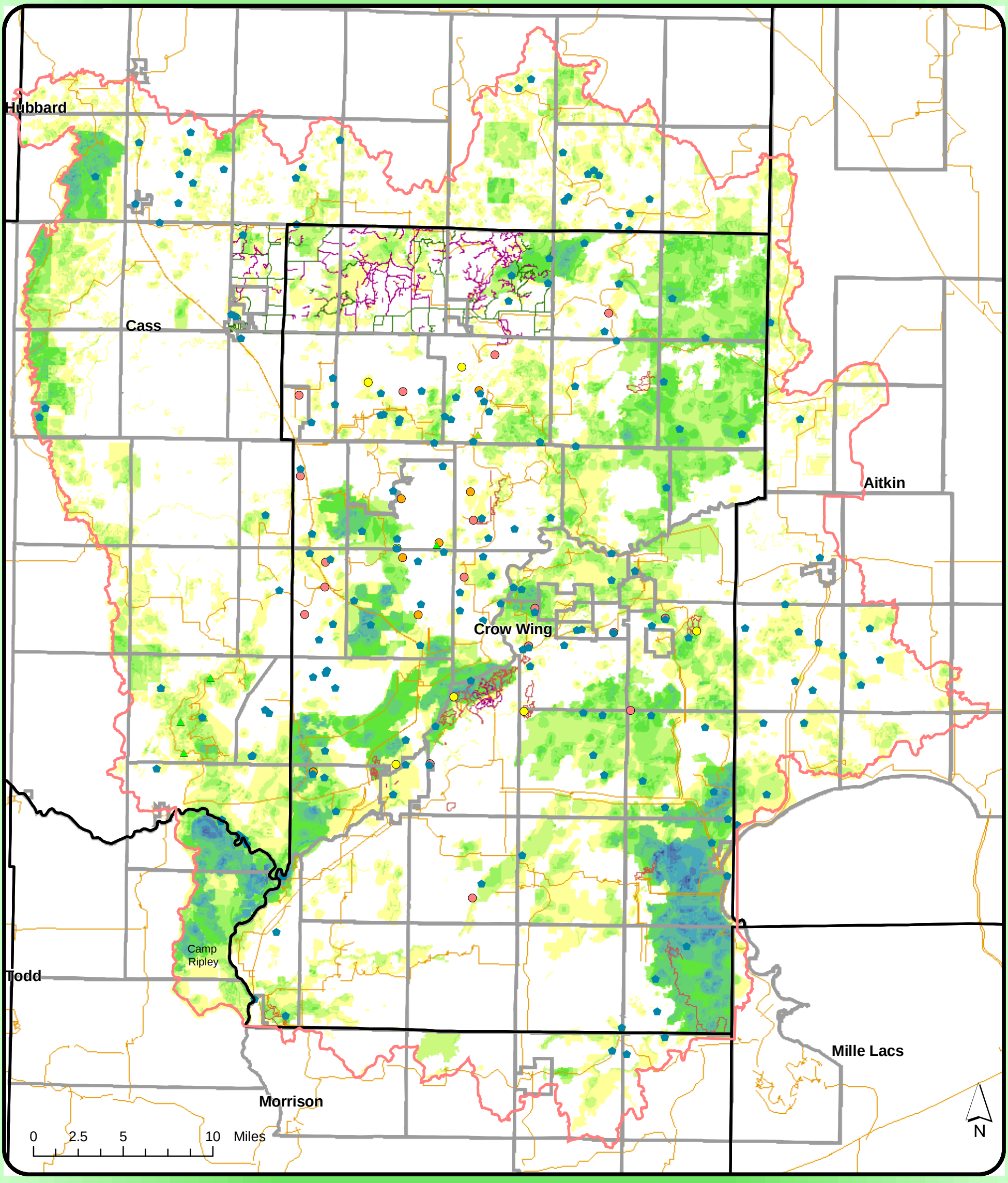

Potential Conservation Priority

Higher Priority | | | | | | | | | **Lower Priority**

- City Park
- Public Beach
- Other Recreational Area
- Campgrounds
- Boat Access

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Data source:
MN DNR Online Data Deli
MNDOT
Crow Wing County
Compiled by: James Lehnhoff

accessibility to a larger population. This is particularly important for the few remaining public land holdings less than five miles from Brainerd and Baxter (Map 11A).

Because of the relative scarcity of public lands near Brainerd and Baxter, the large land holdings held by Potlatch and other large companies should be considered for passive and active recreational use since, due to changing market conditions, some of these lands are being sold for development rather than held for timber harvesting (Map 3). The proximity of these lands to Brainerd and Baxter along with their accessibility to major transportation routes makes them a potentially valuable resource for recreation and open space protection.

This report focuses on broad recommendations and strategies since most protection or conservation opportunities depend on available funds and land as well as demand from the local population. Because the study region has an abundance of public lands, undeveloped land and lakes, there is the potential for recreational opportunity expansion and open space protection beyond the general recommendations described above. However, it will be more difficult each year to protect these areas without a specific recreation and open space policy because development will eat away at the remaining open space, particularly around the Active use and Opportunity lakes.

Groundwater Protection

Because groundwater is used by virtually all existing residences, many forms of commercial development, and is essential for most new development in the Brainerd Lakes region, it is important to identify where groundwater is particularly susceptible to contamination in order to protect this precious resource. Three data sets are used to identify important groundwater protection areas:

1. Groundwater contamination potential
2. Independent sewage treatment system (ISTS) suitability
3. Urban well locations

Groundwater contamination potential is based on the type of soil or soils between the surface and aquifer where the groundwater is located (Map 12A). Different types of soils transmit pollutants from the surface to the aquifers at different rates. A slower transmission rate makes it possible for the soils to filter out contaminants more easily, which can soften the impact of pollutants on groundwater resources. Conversely, soils that transfer water rapidly are less able to filter out contaminants leading to the potential for more groundwater contamination.

Two data sources were used to locate areas with high, moderate, and low groundwater contamination potential. The Minnesota Geological Survey (2004) recently published a detailed geological map of Crow Wing County, which makes it possible to create a more detailed groundwater contamination potential map that is not yet available for the other parts of the study

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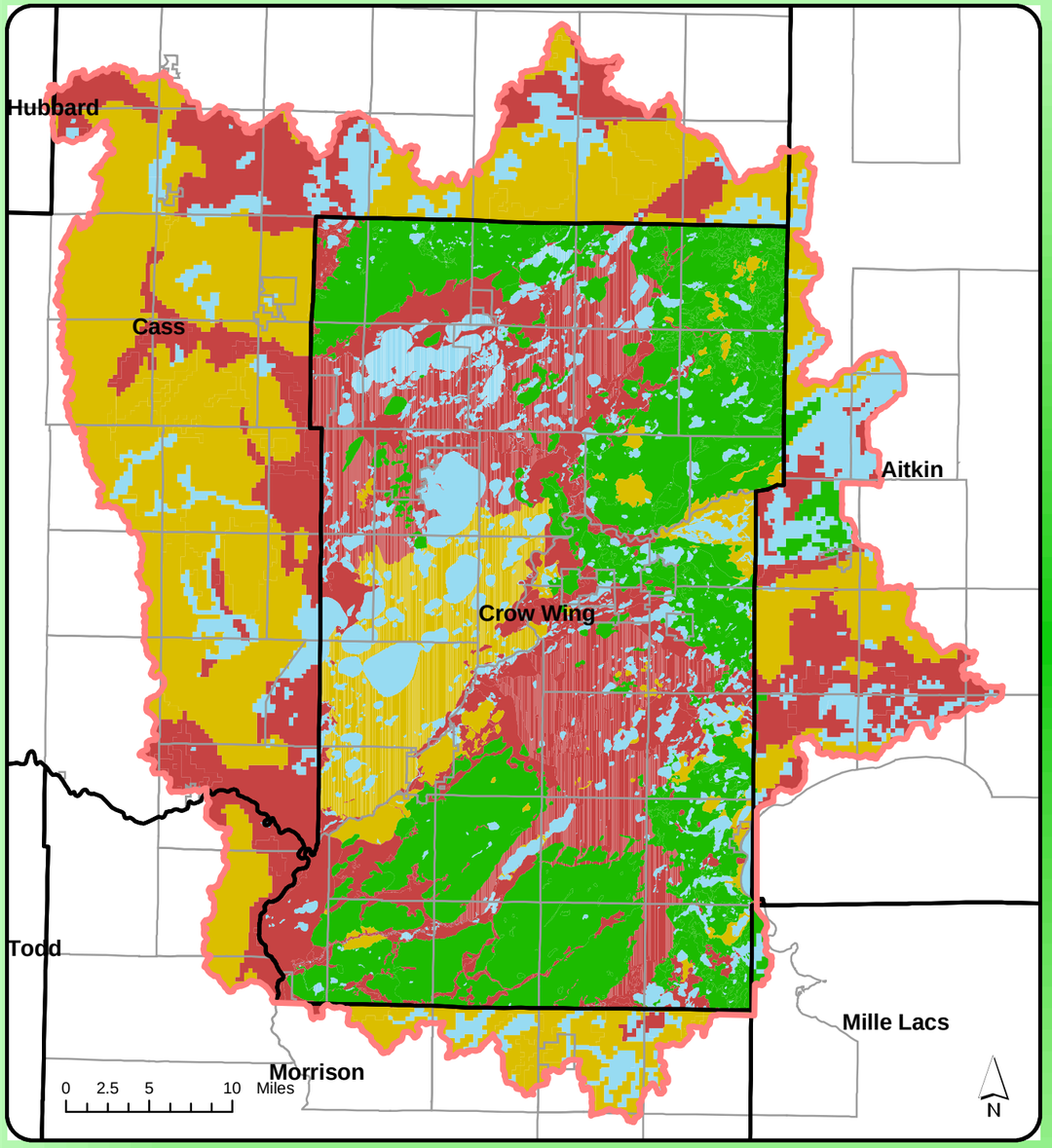
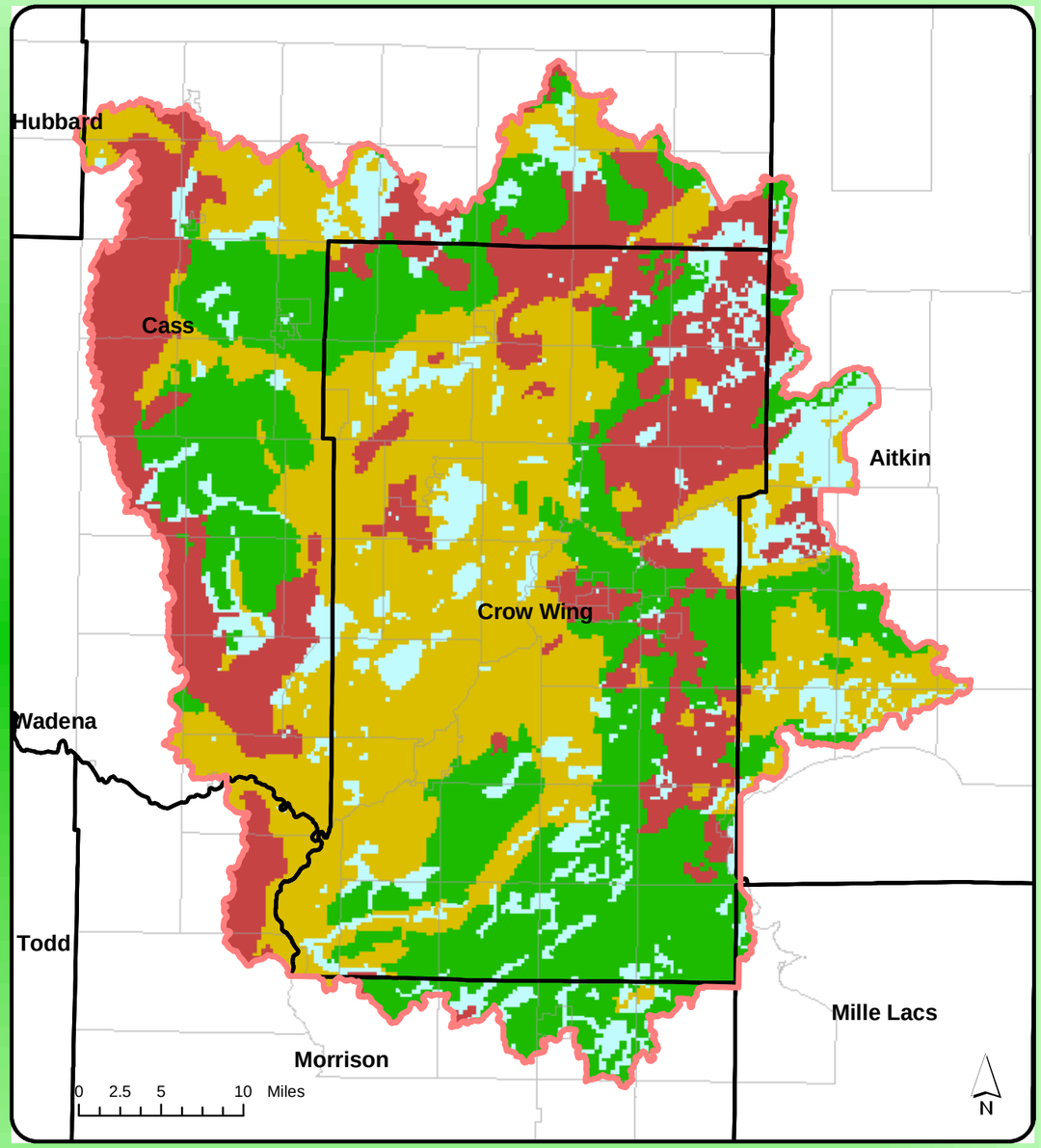
12A - Groundwater Contamination Susceptiblity



12B - Individual Sewage Treatment System Suitability



Groundwater Contamination Potential

- High
- Moderate
- Low
- Water and Wetlands

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Data sources: Minnesota DNR, Minnesota Geological Survey
Borchert Map Library
Compiled by: James Lehnhoff

ISTS Suitability

- Suitable
- Somewhat Suitable
- Severely Limited
- Water and Wetlands

region (Map 12A) [30]. The remainder of the study region uses data from the John R. Borchert Map Library at the University of Minnesota, which was prepared by Daphne Karypis (2000) and derived from the 1975 Minnesota Soil Atlas, which, while still reliable, is less detailed[31].

Since many new developments within the study region are not on centralized water and sewer systems, it is also important to locate where individual sewage treatment systems (ISTS), commonly called septic systems, are more or less suitable for a set of soil conditions and may contribute to groundwater contamination (Map 12B)[32]. Because certain types of soils are more suited to ISTS filtration than other types of soils, the potential for ISTSs to cause groundwater contamination as the waste filters through the soils is more or less likely depending on the soil type at a given location. ISTS suitability was also prepared by Daphne Karypis (2000) and is derived from the 1975 Minnesota Soil Atlas for the entire study area.

The third data set is the location of city wells in Crow Wing County that serve urban populations such as Brainerd, Baxter, and Pequot Lakes (Map 12C)[33]. Although there are far more private wells than urban wells in the study region, these particular wells serve many people off of one source and, therefore, must be protected from contamination. However, because groundwater does not pay attention to municipal borders, contamination in one spot can affect several cities and townships outside the immediate contamination area.

Groundwater Stresses

Groundwater resources face a number of stresses, particularly when considering its importance for human use and development. Stresses include increasing impervious surfaces, road construction, population growth, leaky underground storage tanks, landfills, and animal feedlots (Map 12D). Impervious surfaces, road construction, and increasing population create more pollution, concentrate pollutants, and restrict the aquifer's natural recharge ability. Landfills, animal feedlots, agricultural lands, and leaky underground storage tanks are also direct sources of contamination for groundwater resources.

Although excessive withdrawal and noncompliant septic systems can be serious stresses, that data is not available in a spatial format at this time. Excessive withdrawal refers to the fact that an aquifer contains a finite amount of water and if water is withdrawn faster than the natural recharge rate, the aquifer can empty. Population growth and housing unit growth implies increased groundwater withdrawal and more individual sewage treatment systems (Map 2B). While newly constructed housing is ISTS compliant, older housing, some with non-compliant ISTS systems, have been grandfathered in and are not forced to comply with new ISTS regulations. Furthermore, an increase in the density of ISTSs impairs the soil's ability to effectively treat ISTS waste. Several of the fastest growing cities and townships in the study region are directly over areas with a high groundwater contamination potential (Map 12E).

[30] Minnesota Geological Survey (2004)
[31] Borchert Map Library: Groundwater Contamination Susceptibility & Daphne Karypis (2000)
[32] Borchert Map Library: Individual Sewage Treatment System Suitability & Daphne Karypis (2000)
[33] Minnesota Geological Survey (2004)

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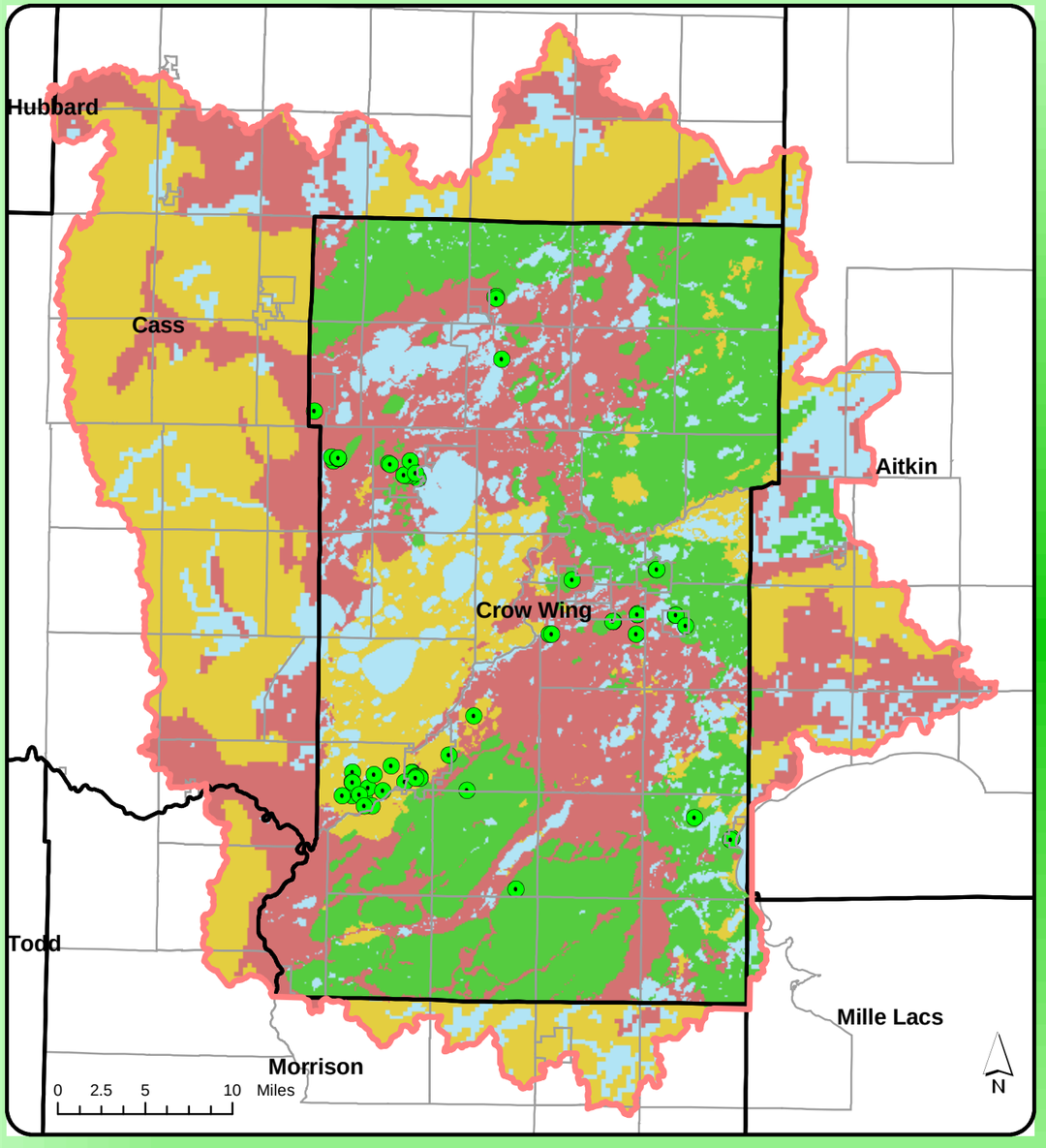
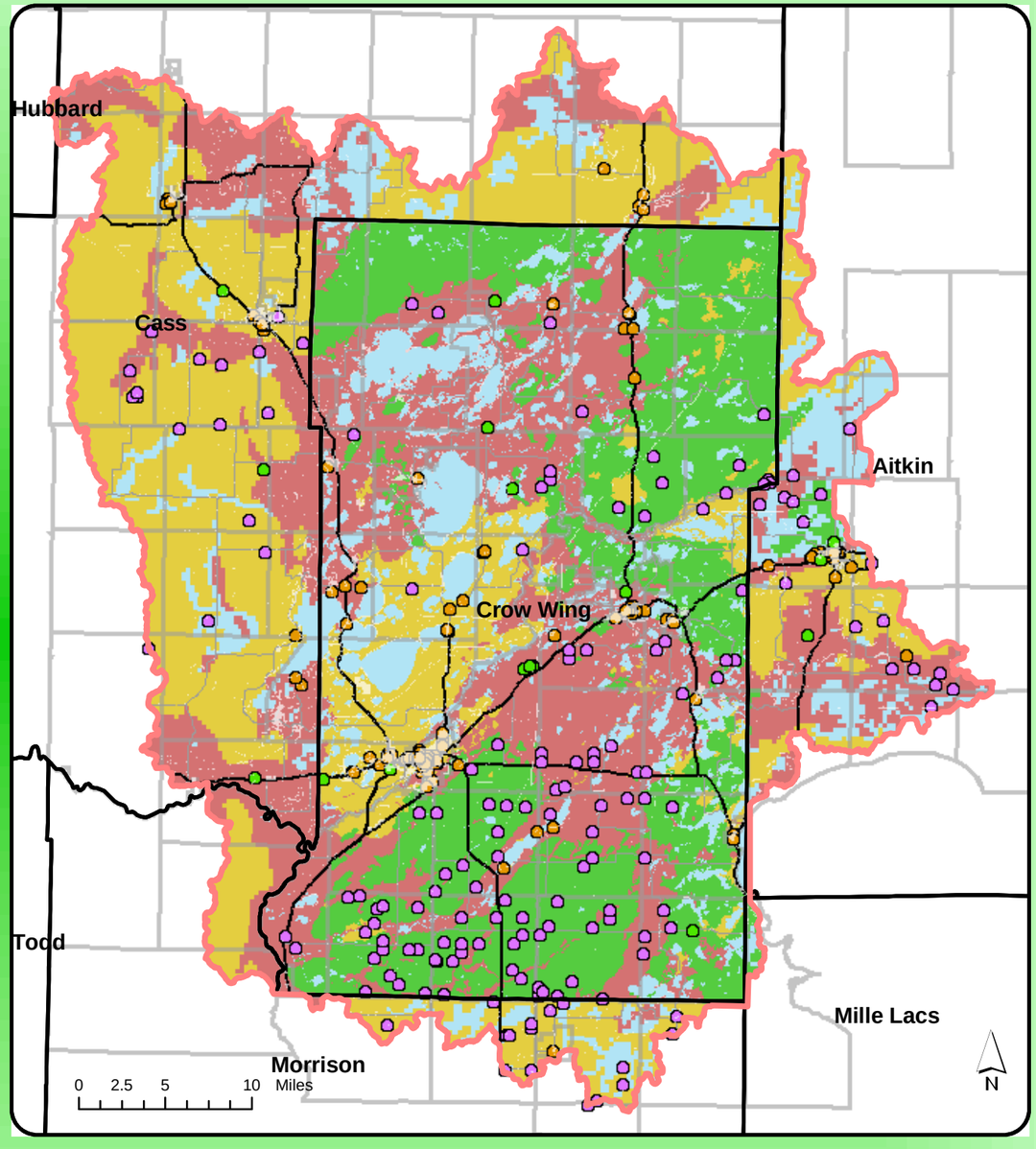
12C - City Wells & Groundwater Contam. Susceptibility



12D - Groundwater Stresses



Groundwater Contamination Potential

- High
- Moderate
- Low
- Water and Wetlands
- City Wells

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Data sources: MN DNR Online Data Deli, Minnesota Geological Survey, MNDOT, Borchert Map Library, MN PCA
Compiled by: James Lehnhoff

Groundwater Contamination Potential

- High
- Moderate
- Low
- Water and Wetlands
- Leaky Underground Storage Tanks
- Impervious Surfaces

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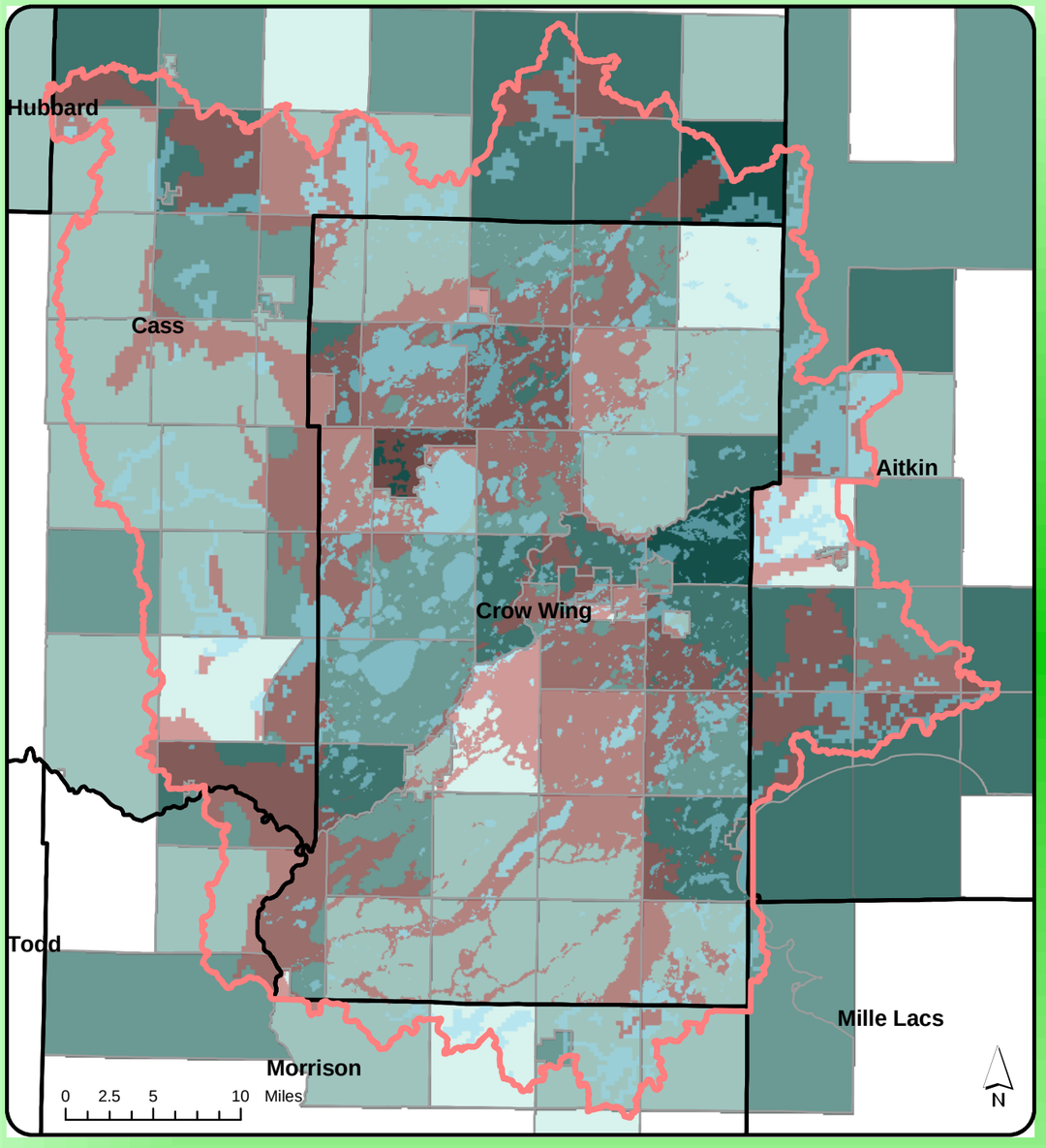
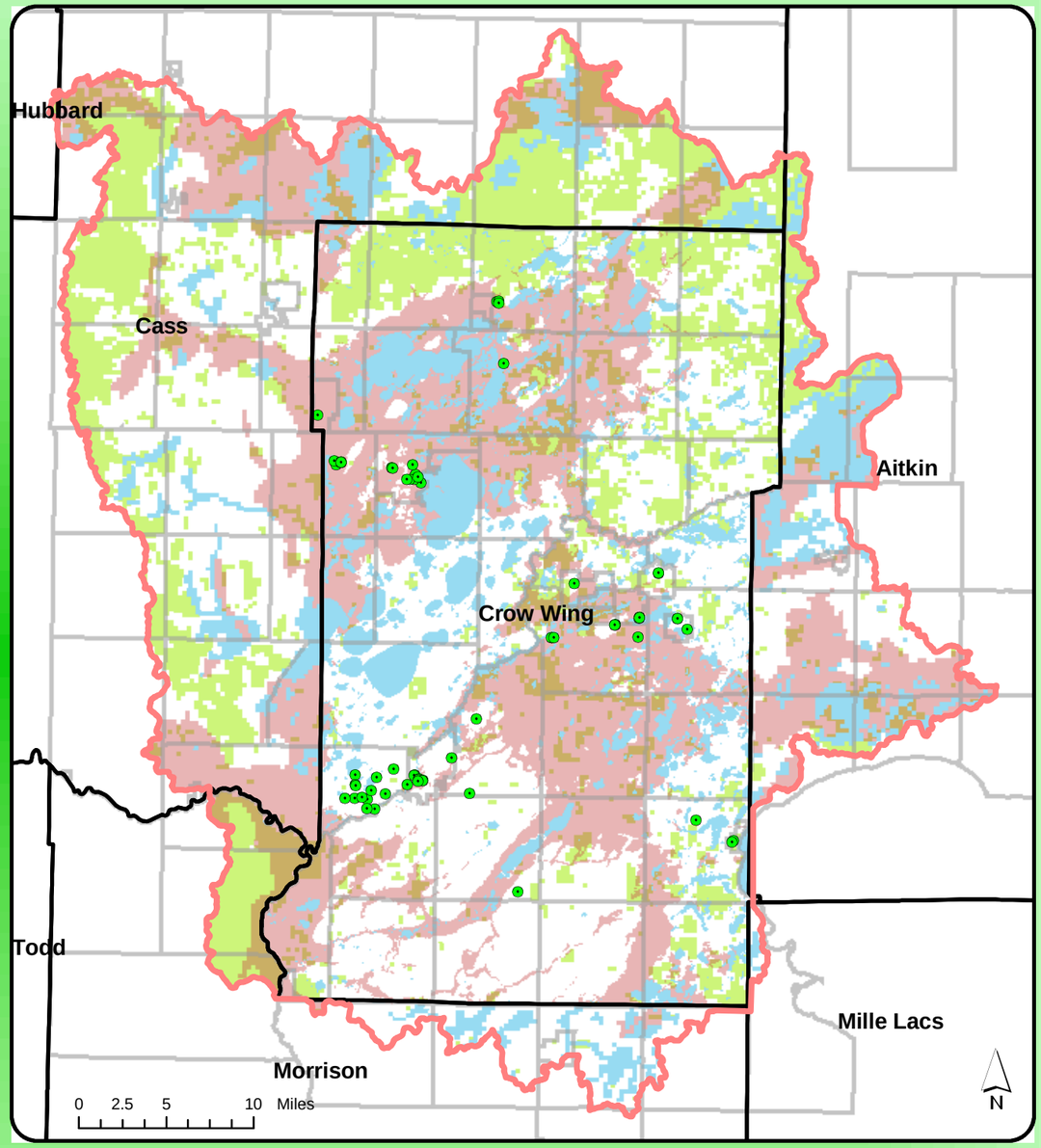
12E - Groundwater Contam Potential & Pop Growth



12F - Groundwater Contam & Public Land



Percent Change 90-00

- -25 - 0
- 1 - 24
- 25 - 43
- 44 - 67
- 68 - 127

- High Groundwater Contamination Potential
- Water

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Data sources: MN DNR Online Data Deli
Minnesota Geological Survey, Borchert Map Library
1990 & 2000 US Census of Population and Housing

Compiled by: James Lehnhoff

- High Groundwater Contamination Potential
- Public Land
- Water
- City Wells

Groundwater Protection Recommendations

Point sources such as leaky underground storage tanks, landfills, and animal feedlots are relatively easy to locate and both new landfills and animal feedlots require permits (Map 12D). Non-point sources of stress such as urban development, agricultural runoff, and road construction can be located but are more difficult to attribute to specific points of pollution and therefore can be more difficult to regulate. Currently, nearly three quarters of the known landfills, approximately one quarter of the feedlots, and just under three quarters of the known leaky underground storage tanks in the study region are in the high contamination potential area for groundwater. Expansions of any of these uses should be restricted within the high contamination potential zone and emergency response plans prepared.

In addition to the point sources of stress on groundwater, there are also land uses that stress groundwater resources (Map 12D). Urban and agricultural uses are both sources of groundwater contamination across a larger land area than individual point sources. Impervious surfaces also restrict aquifer recharge and while the land covered by buildings appears small, roads, driveways, sidewalks, and other built surfaces increase and concentrate, which can increase the chance for groundwater pollution and, as an additional side affect, erosion.

Although the areas not suited for ISTS are, for the most part, outside of high growth cities and townships, the areas with a high potential for groundwater contamination are located almost squarely in the high growth cities and townships (Map 12E). Much of the area classified as low suitability for ISTS is in publicly owned areas (Map 12E). Unfortunately, very little of the high groundwater contamination potential land is within public ownership (Map 12F). While it is not practical to completely restrict development in these areas, it would be prudent for local units of government to limit certain types of development, promote cluster developments, encourage centralized sewer systems, and further limit the amount of impervious surfaces among other potential strategies.

Cities in the study region that have municipal water and sewer systems will require a different approach for protecting groundwater quality. Since these wells serve a larger population than most of the other wells in the area, it is particularly important to protect the aquifers that serve these wells. However, many of the city wells are within areas of high potential for groundwater contamination (Map 12F). Because groundwater does not follow municipal boundaries, groundwater protection requires cooperation across government units to reduce contamination potential.

Protecting groundwater supplies must take a regional approach requiring cooperation among all of the local governments and landowners in the region because groundwater extends beyond political boundaries. Zoning and development, along with ensuring that all ISTSs are inspected and in compliance, will affect the potential for groundwater contamination. Furthermore, having an emergency groundwater protection plan can also help contain and hopefully control contamination from accidents. Individuals can help protect groundwater by not using fertilizers, building stormwater retention and treatment ponds on their property, controlling runoff, and voluntarily limiting impervious surfaces. These areas can be developed as long as development is compatible with groundwater protection and basic steps are taken to reduce and eliminate contamination sources.

DEVELOPMENT SUITABILITY

While the primary goal of this report is to provide local stakeholders with information on the natural and recreational resources and opportunities in Crow Wing County, this report recognizes that Crow Wing County's population is growing and development is a part of the region's future. In fact, there are many areas of Crow Wing County that are suitable for development and would produce minimal impact on ecologically significant natural resources. In order to help guide development, the following analysis creates a rudimentary development suitability indicator map to show where future development might be directed.

In 1996, only about 2.4 percent of the land was classified as developed (Map 2A). Even if one was to restrict all development in the identified conservation priority areas (Map 9A), keep all remaining public lands under public ownership, remove all lakes and wetlands from development, and compensate for existing developed land, the study area would still have nearly 30 percent of the land available for development, which is nearly thirteen times the land currently developed. Of course not all of the remaining 30 percent of land may be suitable for development in terms of location or other conditions that prohibit new development, such as steep slopes or poor soil conditions.

While not all lands are created equal in terms of ecological significance, the same is true for development suitability. Certain lands, due to accessibility, terrain type, or other factors, are more suitable for development. Rather than indicate where development should not occur, this section will indicate where development is potentially more or less suitable. Unfortunately, the larger scale and lack of detailed data prohibits this report from recommending where specific types of development, such as residential or commercial development, should occur. As with all the maps in this report, the development suitability indicator map is not intended to provide information for parcel-specific development; instead, it should be used to indicate where certain areas may or may not be suitable for development and to indicate where concern should be taken due to area wide environmental conditions.

The development suitability map was created using seven common variables that affect where development should or should not occur:

1. Groundwater contamination potential (Map 12A)
2. ISTS Suitability (Map 12B)
3. Erosion susceptibility[34] (13A)
4. Slope[35] (Map 13B)
5. Proximity to existing roads (Map 13C)
6. Proximity to open water (Map 13D)
7. Potential conservation priority areas (Map 9A)

[34] Borchert Map Library & Daphne Karypis (2000)
[35] USGS Seamless National Atlas: 30 Meter Digital Elevation Model

The groundwater contamination and ISTS suitability were discussed in the Healthy Natural Communities section of this report. Since most existing and new developments rely on ISTS systems for sewage processing, building in areas with low suitability for ISTSs and high susceptibility for groundwater contamination can have long-term consequences due to the potential for groundwater contamination.

Erosion susceptibility is based on the soil type of a particular area (Map 13A). Disturbing lands prone to erosion can contaminate waterways with polluted runoff, increase the nutrient and sediment loads in waterways, remove fertile topsoils, wash away native plants, and, in some cases, threaten property values due to damage. The erosion susceptibility data was created for the entire state and only areas of low to medium erosion susceptibility are in the study region. The potential for erosion is spread throughout the study region, though the central portion is particularly susceptible.

Although the Brainerd region is far from being mountainous, there are locations with steep slopes that inhibit development. Slope is calculated using existing elevation data and a digital elevation model, which is provided by the United States Geological Service and classified into three categories. Suitable building areas have less than a twelve percent slope, and development is limited to areas with slopes between twelve and twenty-five percent. Those areas with more than twenty-five percent slope are severely restricted for development. The percent of slope is calculated based on the rise in elevation in feet across 100 feet of distance. For example, a slope of 25 percent indicates a rise in elevation of 25 feet across a distance of 100 feet. Most of the study region is relatively flat; however, there are locations where steep slopes restrict development (Map 13B).

Because roads fragment natural habitats, increase edge habitat, and can lead to increased stormwater runoff and erosion, it is better to develop near existing roads to reduce the need for new roads across undeveloped lands. It is also usually more affordable to build closer to roads and city infrastructure to reduce constructions costs for the city and the homeowner. Virtually the entire study region is within one mile of an existing road (Map 13C). Those areas closer to roads, however, are more suited for development due to their greater accessibility.

Although many people yearn to live near water, building near the lakeshore can have an adverse impact on the lake, river, wetlands, or water table. Removing the natural vegetation can increase erosion and allow nutrients and other pollutants to enter the water systems. Additionally, wherever a lake exists, the water table is also close the surface. In places where the water table is closer the surface, there is a greater chance of surface and groundwater contamination. The lakeshores also serve as important habitats for terrestrial and aquatic species. Therefore, cautionary buffers were placed around all lakes and wetlands (Map 13D). This does not mean that development should be completed restricted around lakes; however, caution should be taken to protect all surface and ground water.

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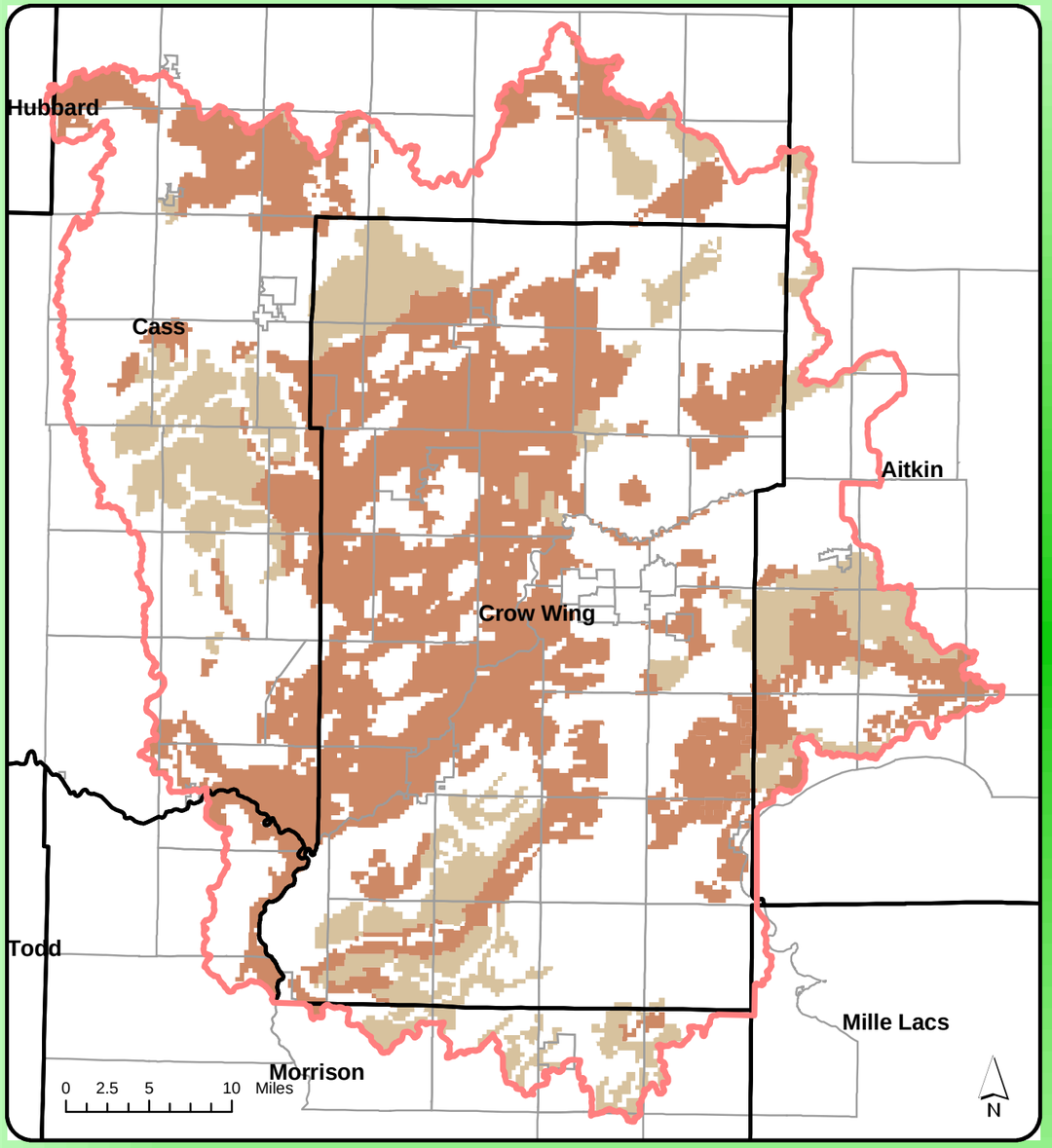
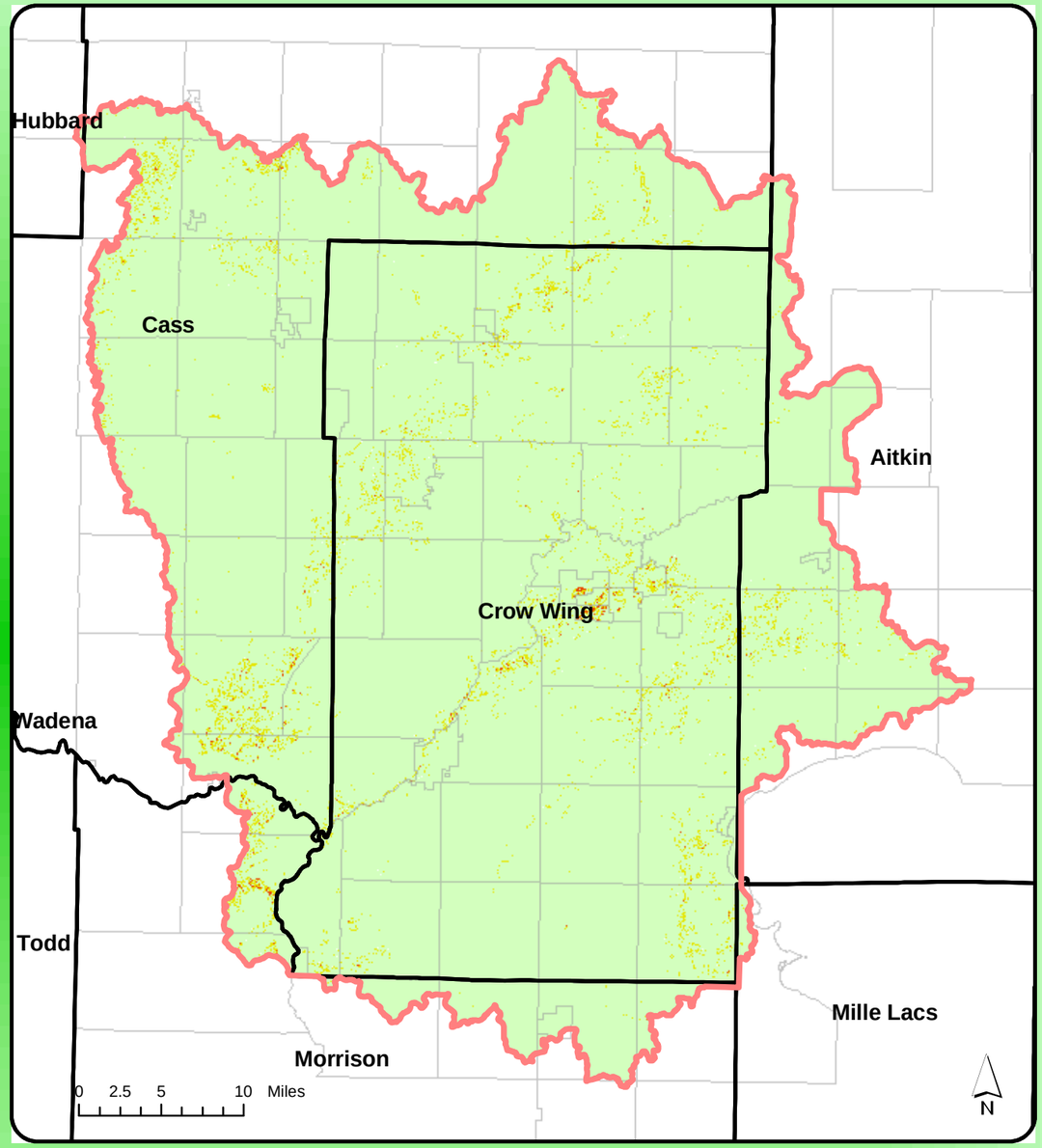
13A - Erosion Susceptiblity



13B - Slope Rating



Erosion Susceptibility

- Low
- Medium

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Data sources: MNDOT, USGS Seamless National Atlas DEM
Borchert Map Library
Compiled by: James Lehnhoff

Slope Rating for Development

- Suitable - < 12%
- Limited - 12 - 25%
- Severely Limited - > 25%

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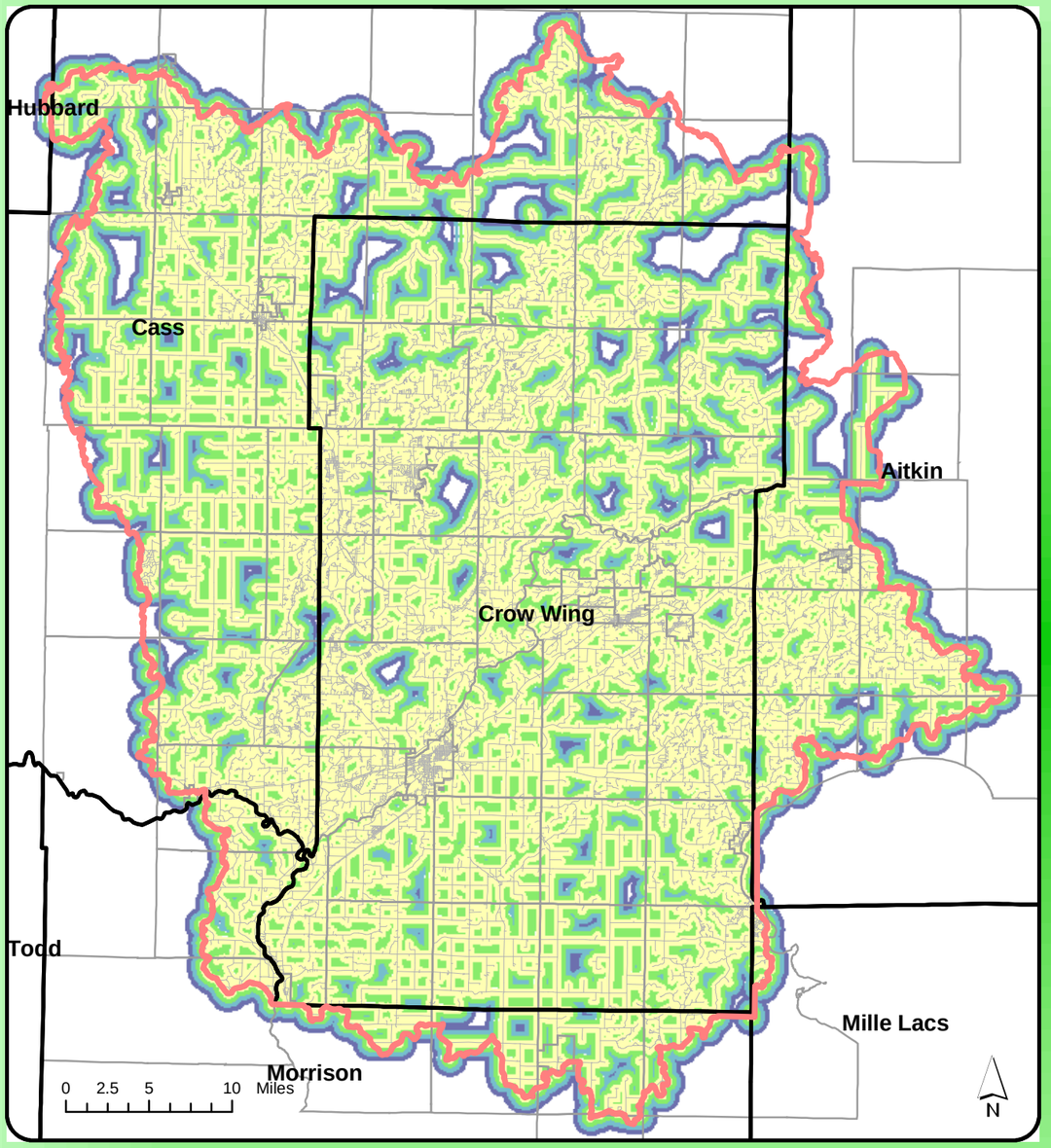
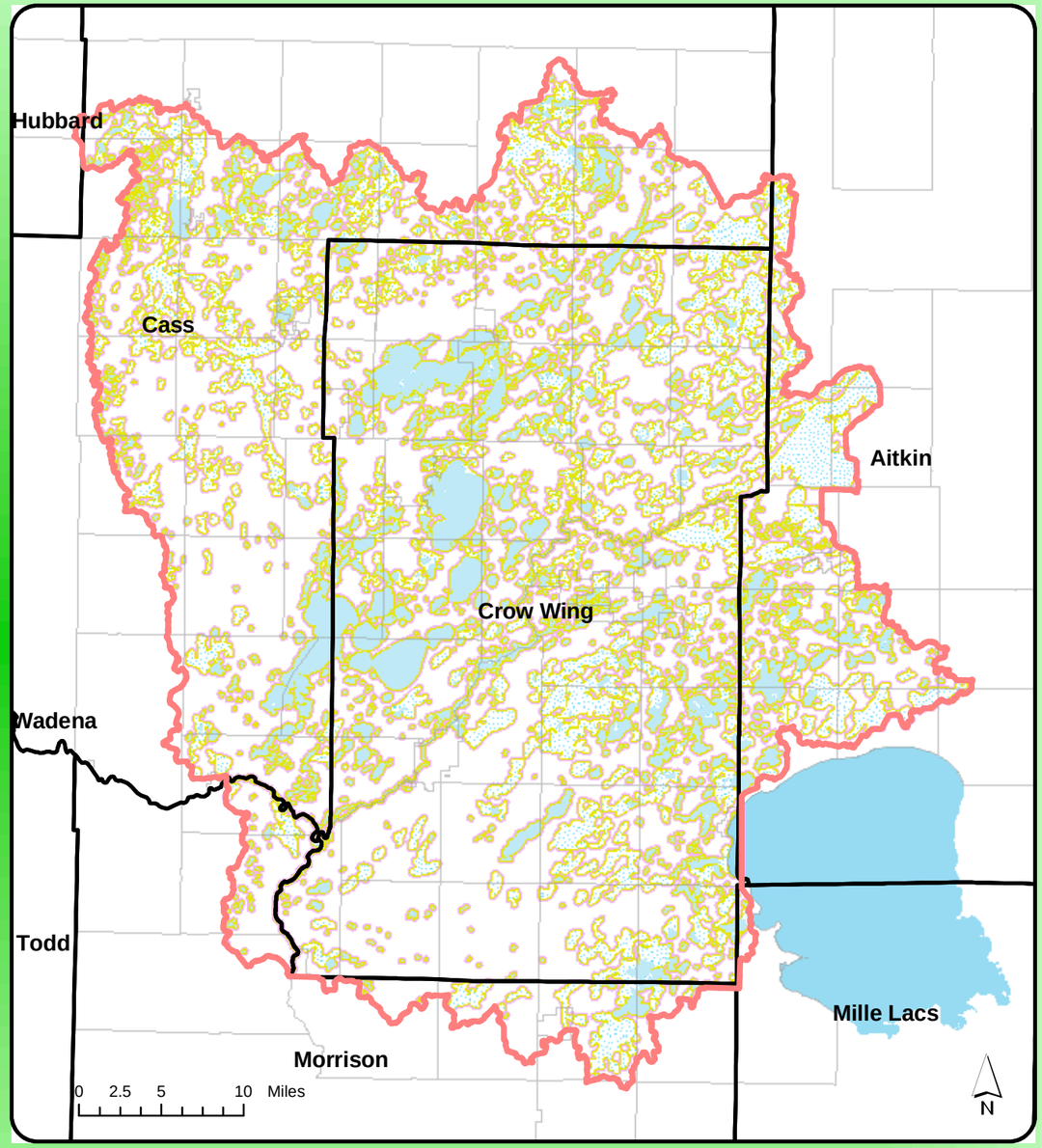
13C - Proximity to Roads



13D - Proximity to Lakes and Wetlands



Road Buffer

- 0 - 1/4 Mile
- 1/4 - 1/2 Mile
- 1/2 - 3/4 Mile
- 3/4 - 1 Mile
- Streets and Roads

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Brainerd Lakes Area Conservation Collaborative, 2004

Data sources: Map Library, MNDOT, MN DNR Online Data Deli
Compiled by: James Lehnhoff

Buffer Distance

- 0 - 500 Feet
- 500 - 1000 Feet

The variables describes above, along with the Potential Conservation Priorities areas (Map 9A), were incorporated into the Development Suitability Indicator Map (Map 14A). In order to map areas of low or high development suitability, these variables were combined using the technique applied to the Potential Conservation Priority Area Map. Essentially, development suitability is based on the number of overlaps between each of the data sources. Areas with a high potential for groundwater contamination, a steep slope, and a high potential conservation priority level indicate, for example, an area not well suited for development.

While the Development Suitability Indicator Map displays development suitability across the entire study region, some lands have been removed from development due to public ownership in state and county parks, state and county forests, Camp Ripley, and other public lands. Remaining private lands and their development suitability are displayed in Map 14B, Development Suitability Indicator on Private Lands. Although a number of severely limited areas in terms of developed are on public lands, the Development Suitability Indicator on Private Lands map clearly indicates that severely limited areas are distributed throughout the study region on private lands.

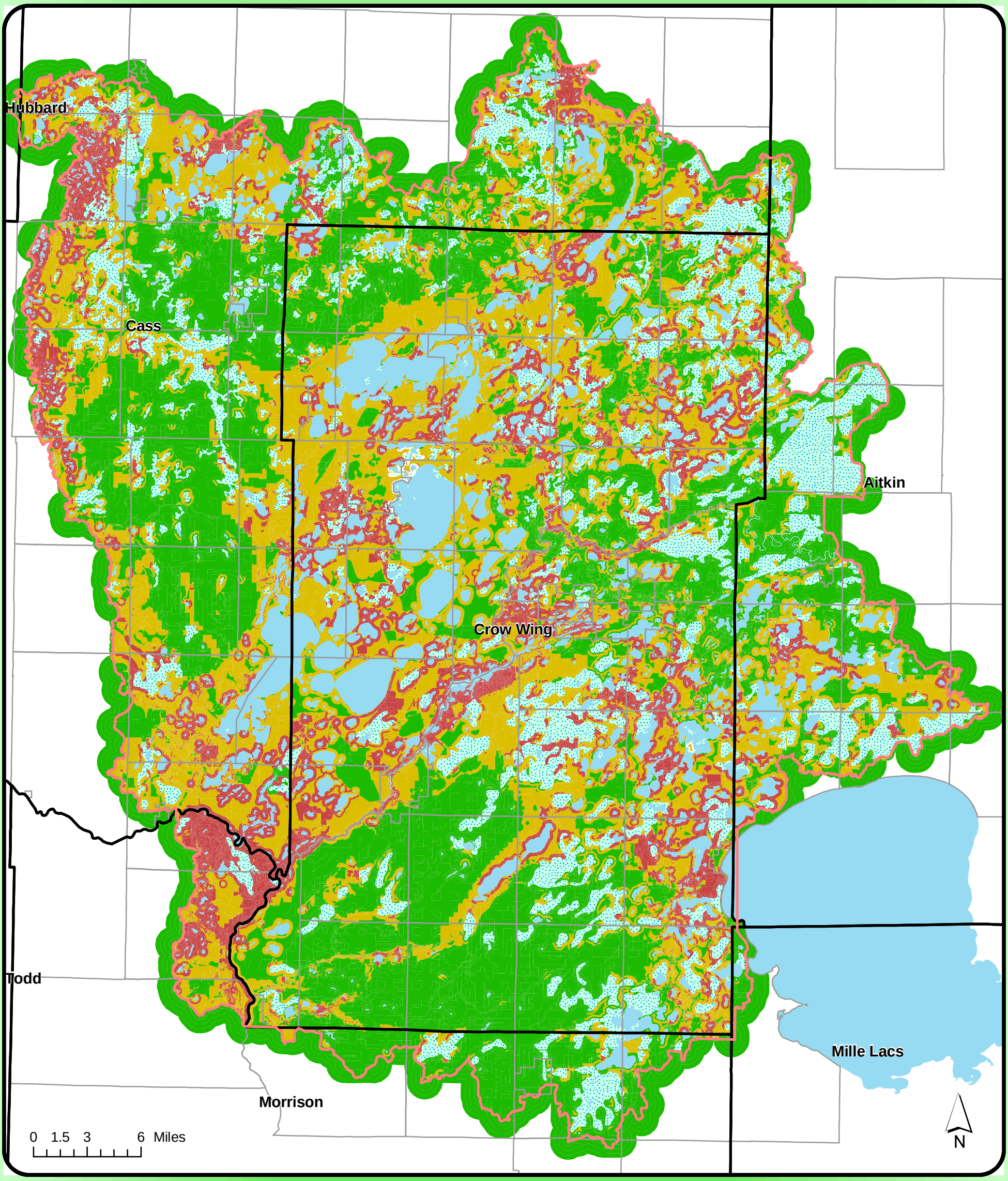
There appears to be a trend of low development suitability long the major lakes in the western half of Crow Wing County. This area's biological importance, terrain conditions, and groundwater contamination potential are definite factors in this classification. It should be noted that a number of the severely limited lands are also in the fastest growing communities, particularly in Baxter, Breezy Point, Garrison Township, and Crosslake. While some of the severely limited areas may be developed, these should be considered special areas of concern for protecting the natural environment and ensuring safe, high-quality construction. Any development in the limited or severely limited areas should take special care of environmental constraints.

The southern portion of the study region appears to be more open to development, and this is almost certainly because of the lower conservation priority level assigned earlier in this report. However, the southern portion is also home to most of the remaining agricultural lands in the study region, which can be important for preserving open-space and rural character.

While the Development Suitability Indicator Map does present the hard data, it lacks input from local landowners, culturally significant locations, and does not include data on demand. This map should be used to help inform people of the many natural resource conservation opportunities and development opportunities in Crow Wing County as decisions are made to site new developments and protect the natural environment.

Map 14A - Potential Development Suitability

Brainerd Lakes Area Conservation Collaborative



Development Suitability

- Suitable
- Limited
- Severely Limited

Development suitability is based on the following data:
-- Groundwater contamination potential (Map 12A)
-- ISTS suitability (Map 12B)
-- Erosion susceptibility (Map 13A)
-- Proximity to existing roads (Map 13B)
-- Proximity to open water (Map 13C)
-- Slope (Map 13D)
-- Potential Conservation Areas (Map 9)

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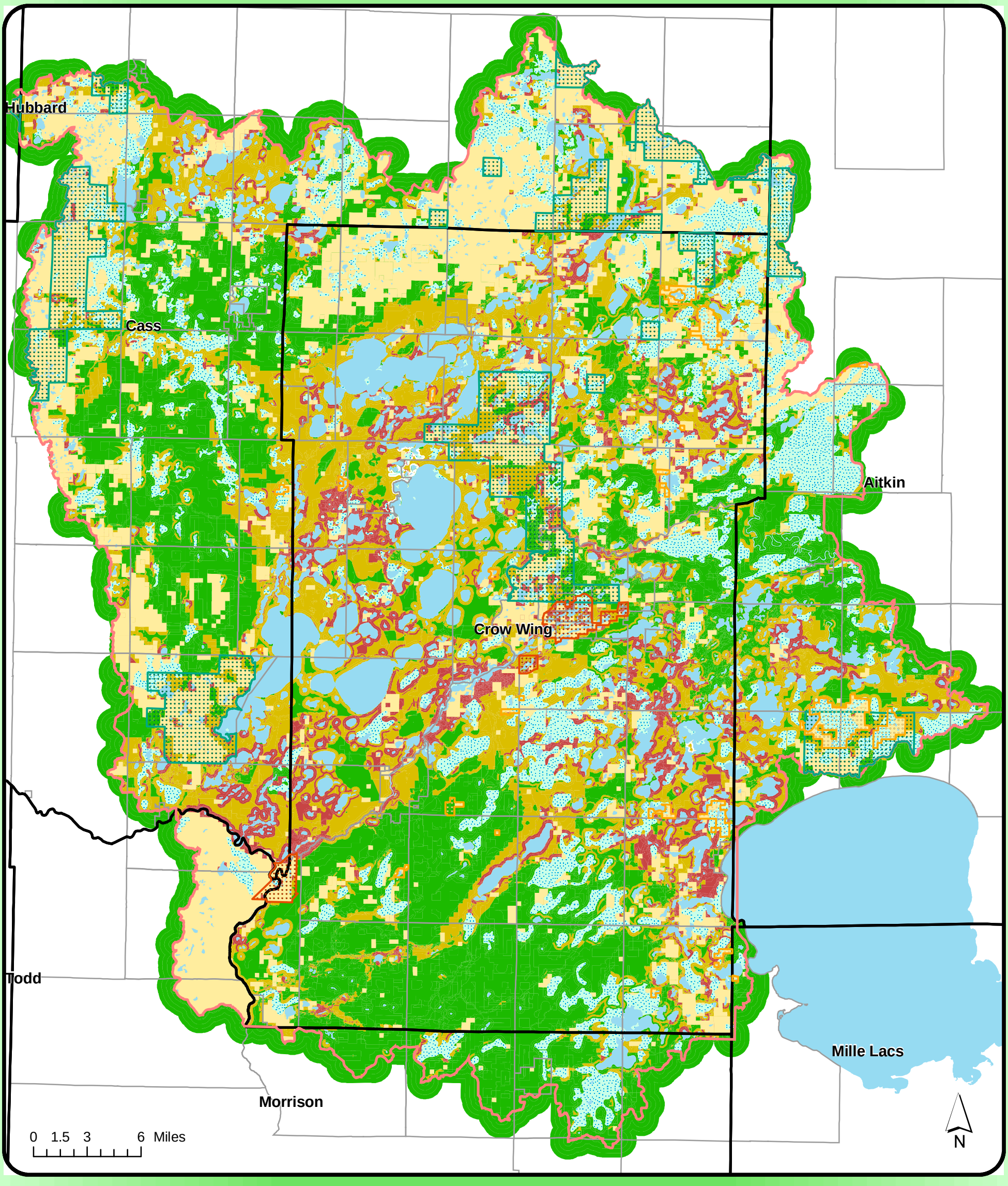
Brainerd Lakes Area Conservation Collaborative, 2004

Data sources: MN DNR Online Data Deli, MNDOT, Borchert Map Library, USGS Seamless National Atlas
Compiled by: James Lehnhoff

Map 14B - Development Suitability Indicator on Private Lands

Brainerd Lakes Area Conservation Collaborative



Development Suitability

- Suitable
- Limited
- Severely Limited
- DNR Wildlife Management Area
- State Park
- State Forest
- Public Lands

Development suitability is based on the following data:
-- Groundwater contamination potential (Map 12A)
-- ISTS suitability (Map 12B)
-- Erosion susceptibility (Map 13A)
-- Proximity to existing roads (Map 13B)
-- Proximity to open water (Map 13C)
-- Slope (Map 13D)
-- Potential Conservation Areas (Map 9)

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Data sources: MN DNR Online Data Deli, MNDOT, USGS Seamless National Atlas, Borchert Map Library
Compiled by: James Lehnhoff

CONCLUSION

The Potential Conservation Priority Map (Map 9A) and the Development Suitability Indicator Map (Map 14A) are the feature tools of this report and serve to help inform local governments and residents to guide development where it is more suited and to protect the significant natural resources in Crow Wing County. It is hoped that the information and recommendations presented in this report will be used as a starting point and a tool to help people in the Crow Wing County area make decisions regarding development, conservation, and recreation. This document is not a full plan; however, it is a framework that can be used by citizens and local governments to plan the future of their land and natural resources.

Appendix D of this report includes ideas and recommendations compiled by BLACC members for citizens, local governments, and non-profit organizations to move forwarding promoting groundwater protection, open space networks, and recreational opportunities. While these suggestions are not comprehensive, they do provide a starting point for many communities and organizations to use the information provided in this report and move forward in protecting their natural resources.

While the recommendations in this report are based on sound data, one key component is missing—public comment. It must not be forgotten that people already live in the Brainerd lakes region and thousands more people are expected to relocate there over the next thirty years. Public input must be used to help shape final recommendations for conservation, recreation, and development corridors.

In order to be successful, it will take action on the part of stakeholders to ensure that the natural beauty that draws people to this part of Minnesota is not paved over or disconnected by irresponsible development. Protecting the environment and encouraging sustainable development will take the cooperation and effort of all stakeholders, from residents to local governments, to preserve the region's unique character. Various techniques to accommodate both development and natural preservation do exist and could be included in county ordinances, comprehensive plans, and individual developments if the Brainerd region is to remain a vital growth area. Protecting the significant natural and recreational resources serves to maintain the beautiful character of the region and the economy.

The reoccurring theme of this report is that natural resource conservation, recreation, and development does not have to be mutually exclusive. The ecologically significant natural resources, recreational opportunities, and development potential identified in this report are mutually supporting and, when united, these characteristics contribute to the health, beauty, and economic viability of Crow Wing County.

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- *Groundwater contamination potential*
- *Individual sewage treatment system suitability*
- *Erosion susceptibility*
- *Scenic amenities*

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- *DLG Hydrography Lakes and Wetlands*. http://deli.dnr.state.mn.us/metadata/full/dlglkpy2.html
- *DLG Streams*. http://deli.dnr.state.mn.us/metadata/full/dlgstln2.html
- *Farm Service Administration Color Orthophotos 2002*. http://deli.dnr.state.mn.us/metadata/full/fsa01im4.html
- *GAP Stewardship*. http://deli.dnr.state.mn.us/metadata/full/gapstpy2.html
- *Hybrid County Boundaries*. http://deli.dnr.state.mn.us/metadata/full/ctybdne2.html
- *LandSat Based Land Use-Land Cover (Vector).* http://deli.dnr.state.mn.us/metadata/full/lusatpy3.html
- *Minnesota Snowmobile Trails.* http://maps.dnr.state.mn.us/deli/metadata.html?id=L390002190202
- *Presettlement Vegetation.* http://deli.dnr.state.mn.us/metadata/full/prvegpy1.html
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- *Municipal Boundaries.* http://www.dot.state.mn.us/tda/basemap/metadata/Muni.htm#eainfo.
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- *Feedlot Program.* http://www.pca.state.mn.us/hot/feedlots.html
- *Landfill Program*. http://www.pca.state.mn.us/cleanup/landfills.html
- *Leaky Underground Storage Tank (LUST) Program* http://www.pca.state.mn.us/programs/lust_p.html
- *Wastewater Program* http://www.pca.state.mn.us/water/wastewater.html
- *Total Maximum Daily Load and Minnesota Waterways: 303d List.* http://www.pca.state.mn.us/water/tmdl.html
- *Assessment of Lake Conditions in Minnesota Major River Basins: 305b List.* http://www.pca.state.mn.us/water/basins/305blake.html

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APPENDIX A: COUNTY BIOLOGICAL SURVEY

The full County Biological Survey Data for Crow Wing County was still in production as of August 2004. The following text is from the Minnesota County Biological Survey website at the Minnesota Department of Natural Resources describing their mission:

The Minnesota County Biological Survey (MCBS) began in 1987 as a systematic survey of rare biological features. The goal of the Survey is to identify significant natural areas and to collect and interpret data on the distribution and ecology of rare plants, rare animals, and native plant communities.

Native habitats surveyed by MCBS contribute to a sustainable economy and society because they:

- Provide reservoirs of genetic materials potentially useful in agriculture, medicine, and industry.
- Provide ecological services that contribute to the quality of air, soil, and water.
- Provide opportunities for research and monitoring on landscapes, native plant communities, plants, animals and their relationships within the range of natural variation.
- Serve as benchmarks for comparison of the effects of resource management activities.
- Are part of natural ecosystems that represent Minnesota's natural heritage and are sources of recreation, beauty and inspiration.

A map of survey status across Minnesota can be found at:
http://www.dnr.state.mn.us/ecological_services/mcbs/outcomes/map.html

Text describing the County Biological Survey can be found at:
http://www.dnr.state.mn.us/ecological_services/mcbs/index.html

For more information about the County Biological Survey, please contact:
Carmen Converse, Supervisor
carmen.converse@dnr.state.mn.us
500 Lafayette Rd Box 25
St Paul, MN 55155-4025
(651) 296-9782

APPENDIX B: LAKE USE CLASSIFICATION

For the purposes of this report, lakes were divided into three categories based on their general or potential use. These categories are:

1. Active Use Lakes
2. Opportunity Lakes
3. Wildlife/Natural Environment Lakes

Although these categories are meant to help residents, planners, and policy makers to determine the current and future use of a given lake, classifications may change depending on need and on-site examination.

Active Use Lakes – These lakes have at least 250 dwellings along the shorelines, which, with an average of 2.5 people per household, makes them larger than half of the towns in Minnesota. They are classified as general development or recreational development by the DNR, have at least one boat access, and little or no remaining public ownership along the lakeshore. These lakes are generally the most popular lakes for both development and tourism, i.e. Gull Lake, the Whitefish Chain, and several other large lakes.

Opportunity Lakes – These lakes have less than 250 dwellings but do have some development. Most lakes have at least some public land along the lakeshores and most have boat access. The DNR classifies these lakes as recreational development or natural environment lakes. This classification covers a wide range of lakes. They are considered opportunity lakes because they are increasingly under pressure for more development and tourism; however, many are also relatively undeveloped and suited for conservation purposes. In the coming years, these lakes have the opportunity to become fully developed, conserved, or a mixture of conservation and development.

Wildlife/Natural Environment Lakes – Lakes in this classification have little or no development, an abundance of publicly owned lakeshore, and are classified by the DNR as natural environment Lakes. These lakes generally have less desirable water type and shorelines, which makes them less suited for recreation or development. Therefore, these lakes are more open to conservation for wildlife protection.

APPENDIX C: DNR LAKE CLASSIFICATIONS

The Minnesota Department of Natural Resources has classified most lakes in Minnesota into three categories:

1. General Development
2. Recreational Development
3. Natural Environment

These classifications are used by the DNR and local municipalities to create minimum development standards, often in zoning ordinances, along lakeshores and rivers. General Development lakes tend to be less restrictive while Natural Environment lakes tend to be more restrictive in terms of development. The lakes are classified based on the following characteristics:

General Development – usually have more than 225 acres of water per mile of shoreline and 25 dwellings per mile of shoreline, and are more than 15 feet deep.

Recreational Development – usually have between 60 and 225 acres of water per mile of shoreline, between 3 and 25 dwellings per mile of shoreline, and are more than 15 feet deep.

Natural Environment – usually have less than 150 total acres, less than 60 acres per mile of shoreline, and less than three dwellings per mile of shoreline. They may have some winter kill of fish; may have shallow, swampy shoreline; and are less than 15 feet deep.

Lake classifications in the BLACC study area are shown on Map 10C.

More information can be found on the DNR website at:
http://www.dnr.state.mn.us/shorelandmgmt/guide/classification.html

To maintain healthy human communities in the face of unprecedented population growth in the Brainerd Lakes Area, we all have jobs to do. Below are recommendations for roles and opportunities for individuals, environmental nonprofit organizations and local units of government to enhance the elements necessary for maintaining healthy human communities: groundwater, open space networks and accessible recreational opportunities.

GROUNDWATER:

Clean, safe and affordable access to groundwater is critical to supporting an expanding population of residents as well as businesses. Almost 100% of the population of Crow Wing County gets their drinking water from wells that tap into the groundwater lying beneath the county's sandy soils. Groundwater is also important to Crow Wing County because it is the only source of water for irrigation of fields. In addition, groundwater is a primary source for recharge of the county's 400-plus lakes.

Recommendations for individuals to better protect groundwater:

1. **Maintain your Individual Septic Treatment System (ISTS).** Know what you can and can't put into your ISTS. Have your ISTS pumped on a regular basis (every 2-3 years). If you have problems (like many of us did during the winter of 2002-2003) call a licensed or certified inspector/pumper. They know what they're doing and they know how and where to properly dispose of any septage pumped from your system.
2. **Manage your stormwater runoff.** Minimize the amount of impervious surface on your property. According to a report entitled, *Paving the Way to Water Shortages: How Sprawl Aggravates Drought*, the excessive transformation of natural areas into hard surfaces such as roofs and driveways is sending billions of gallons of polluted runoff directly into our rivers and lakes instead of percolating slowly into the soil to replenish our groundwater supplies. Instead of an asphalt driveway, consider leaving it as dirt or gravel, or use pervious pavers that allow water to infiltrate rather than run off. Limit the footprint of your house. Do you really need 3,000 square feet? If so, consider building up rather than out. Create a rain garden, engineered swales, or a holding pond.

Recommendations for nonprofit organizations to better protect groundwater:

1. **Educate citizens about the connections between development, impervious surface, wastewater treatment, and a healthy groundwater supply.** For example, in natural undisturbed areas where groundwater is sufficiently recharged by rainfall and melting snow, approximately 50% of the rain (or snowmelt) goes directly into the ground and filters into the groundwater for recharging. Zero to 10% becomes stormwater runoff. The rest (approximately 40-50%) evaporates back into the air. In a typical developed area (with an increase in impervious surface area), 55% becomes stormwater runoff. This creates a

situation where there is not enough water infiltrating the ground to sufficiently recharge the groundwater. Citizens need to know about affordable options available to them.

2. **Encourage and support those who are doing something to solve the problem, and seek out alliances and common ground with those who might be contributing to the problem.** The nonprofit environmental community needs to reach out to those individuals and organizations not typically thought of as being "part of the choir." Focus on commonalties rather than differences, and reward and recognize positive developments and solutions.

Recommendations for local units of government to better protect groundwater:

1. **Continue to support and promote low-interest loan programs for ISTS upgrades or replacement of failing systems.** It has been estimated that 20 to 25% of the ISTS's in Crow Wing County do not currently conform to county regulations. Cost should not be a barrier for safe, affordable management of septic waste. It should also not be a limiting factor to achieving a clean supply of drinking water that surpasses all federal and statewide requirements.
2. **Create incentives for citizens and local businesses to minimize impervious surface and maximize on-site retention of stormwater.** Studies show that whenever impervious surface area exceeds 10%, surface water quality begins to degrade as does the ability of the groundwater to recharge. Local units of government should create cost-sharing options for natural lakescaping projects, rain gardens and other stormwater-reducing alternatives. They can promote the use of pervious pavers for driveways. They can also investigate options like creating market incentives for the transfer of impervious rights from one neighbor to another, as proposed by Chuck Marohn of Community Growth Institute.
3. **Allowable impervious surface area should be reduced from 25% to something less than 25%.** 25% impervious surface area is, as studies have shown, contributing to a degradation of both surface and groundwater quality. 20% is better. 15% is better, yet. Through new zoning and subdivision ordinances, local units of government should lower allowable impervious surface areas for new developments as much as is feasible, and encourage existing developments to voluntarily reduce their impervious surface by replacing asphalt parking lots with pervious pavers, or retro-fitting a green roof. For developments located near groundwater recharge areas, allowable impervious surface area should be as close to 10% as possible.
4. **Know where your groundwater recharge areas are, and develop strong Wellhead Protection Programs that exclude high-risk activities such as the storage of hazardous chemicals.** Educate residents and businesses to reduce the risk of accidental spills or other contamination of the groundwater.
5. **Maintain agricultural areas in close proximity to urban areas for ease of septage land application operations.** With an increasing loss of agricultural land for disposal, coupled with increased distances to haul to cooperative farmers, the potential for mismanagement of wastewater solids in the future is a real possibility. Urban areas should consider incentives to keep agricultural areas in production in order to have nearby, affordable locations to safely dispose of septage.
6. **Local units of government responsible for wastewater treatment should work towards 100% ISTS compliance.** This could be accomplished by instituting an enforceable system

in which all homeowners with ISTS's should be able to prove that their ISTS has been pumped by a licensed or certified pumper, inspected by a licensed or certified inspector, and passed within the last three years. There should also be a tracking system for waste disposal.

OPEN SPACE NETWORKS:

Preserving open space is critical to maintaining our small town, "rural" character and our high quality of life in the Brainerd Lakes Area. In addition, it is important for maintaining clean water, clean air, noise abatement, unfragmented wildlife habitat and providing for human recreational activities. In a 2002 survey by the Minnesota Office of Environmental Assistance and Hamline University, Minnesotans ranked specific reasons why they choose a place to live. The number one reason was safety. Number two was Community Green Space/Open Space. This ranked higher than quality of schools, property taxes, commuting distance and the size of their lot.

Recommendations for individuals to preserve open space:

1. **Get involved with your local lake association or neighborhood association to preserve open space in your neighborhood.** Local development issues are often guided/inspired by grassroots groups with strong opinions about what kinds of development are appropriate for maintaining the sense of place of their particular neighborhood.
2. **Make phone calls, write letters and send emails to your elected and appointed officials (your city council, your planning commission, your county commissioners, etc.)**. Let them know how you feel about the need to preserve open space in your community.
3. **Vote in decision-makers who understand the importance of preserving open space in spite of unprecedented growth and development.** Balancing development with conservation is an attainable goal. It just takes forward thinking individuals and political will to make it happen.
4. **Attend and participate in civic meetings to discuss future growth and development in your community.** The rules are made by those who show up to voice their opinions.
5. **Write a tax-deductible check to a nonprofit organization that is working to preserve open space for public benefit.** Some examples are 1000 Friends of Minnesota, The Nature Conservancy, the Minnesota Land Trust, the Trust for Public Land, and the Minnesota Lakes Association.
6. **Run for an elected public office.** Become a member of your city council, or become a county commissioner, or get appointed to your local planning commission or Board of Adjustment. These offices are where the ultimate decisions are made concerning where and how a community grows.
7. **Place a conservation easement on your property, especially if you have a large parcel that might one day be subdivided.** This will ensure that open space will be preserved and no future development will ever take place on your particular parcel. Groups like The Nature Conservancy, the Minnesota Land Trust and the Trust for Public land can help you with this.

Recommendations for nonprofits to preserve open space:

1. **Educate citizens and elected and appointed officials about innovative ways to accommodate growth while still preserving open space.** For example, cluster communities and Conservation Design Subdivisions design housing developments around the central organizing principle of land conservation, and typically set aside a minimum of 50% of the buildable land as permanently protected open space. Jackson Meadow and Fields of Saint Croix are just two examples of how one can increase housing densities, while still preserving rural character and open space. Other innovative tools to permanently preserve open space are programs like Purchase of Development Rights (PDR) and Transfer of Development Rights (TDR). Both tools are legal agreements that allow owners of land meeting certain criteria to sell the right to develop their property. In other words, they get paid for preserving the land as open space, rather than selling it to a developer to become the next suburban subdivision.
2. **Seek out alliances and common ground with land-use planners, developers and realtors to plan, promote and market Conservation Design Subdivisions instead of typical subdivision-style developments that fragment open space by converting all land into a checkerboard of nothing but houselots and roads.** Open space should not be a secondary consideration. It should not be what is left over after coming up with a development plan for a growing human population. A city, county or state would never build a road, water or electrical system piece by piece, or engage in redevelopment without advance planning, assurances of public financing, or coordination among different system components and jurisdictions. It is time to do the same for open space, and that can only be accomplished when all parties are at the table at the very beginning of the planning process. It is up to nonprofits to make sure that happens.
3. **Build unlikely coalitions to preserve open space.** For example, get affordable housing proponents to demand open space in areas where affordable housing is located. Open space isn't just for the wealthy.
4. **Actively seek out individuals interested in placing conservation easements on their properties.** Market it as an option to preserve a way of life, a sense of place, an investment in the future.

Recommendations for local units of government to preserve open space:

1. **Create incentives for developers to build cluster-style developments and Conservation Design Subdivisions that set aside a minimum of 50% of the land as permanently protected open space.** These incentives might include density incentives. For example, a developer would be permitted full density only if at least 50% of the buildable land is maintained as undivided open space. There could be a 25% density bonus if a developer preserved 60% of the buildable land as open space instead of just 50%. Municipalities might also consider offering as much as a 100% density bonus for protecting 70% of the land. Another incentive might be facilitating the planning approval process for a developer with a cluster-style development. Fast-tracking plans that preserve open space would be beneficial for the developer, the community, homebuyers, and the overworked planning commission.

2. **Create a fund to assist cluster-style developers with up-front costs such as communal septic systems.** This could be another incentive to promote developments that preserve open space.
3. **Update local zoning and subdivision ordinances so that they promote cluster- style developments and Conservation Design Subdivisions over more typical suburban-style subdivisions.** Current zoning and subdivision ordinances haven't been changed since the 1970's when populations were small enough (and seasonal) to easily accommodate without gobbling up open space. That is no longer the case. Cluster-style developments and/or Conservation Design Subdivisions also make sense for areas previously zoned as agricultural, but slated for residential development. In these areas, open space preservation should be a priority to maintain the "rural" character of the land.
4. **Create Zoning Overlay Districts and Cluster Overlay Districts for sensitive areas where traditional subdivisions would be inappropriate.** These districts would supercede existing zoning, and would include design standards, special setback requirements, mandatory preservation of large contiguous blocks of open space, and housing densities could be limited or increased depending on contributing factors.
5. **Establish design standards.** These could include things like increased setbacks, limiting impervious surface area, use of pervious pavers, retention of native species, the installation of communal septic systems, and preservation of large blocks of contiguous open space.
6. **Create a TDR ordinance.** Designate sending areas where natural areas are to be protected, and receiving areas where development is encouraged. Typically, sending areas are high-value agricultural land, intact forests, land that holds a potential for future recreational opportunities, and important open space connections. Receiving areas, on the other hand, are areas where there is already existing infrastructure like roads, sewer and water.
7. **Plan out open space as a contiguous network of hubs and linkages, not as isolated pockets sprinkled haphazardly throughout a community.** Hubs are large priority conservation areas that are connected by links, which can be conservation corridors, riparian corridors, greenbelts, trails and even utility corridors. These interconnected, preserved areas should be designated as priority areas where development should not occur, and any development near these areas should be regulated to have minimal impacts on the adjacent areas.
8. **Municipal governments should work closely with their counties to use open space as something to define the outer edges of communities.** This would help limit sprawl, which has been shown to be a major contributor to our nation's rising rates of obesity, hypertension and diabetes.

ACCESSIBLE RECREATIONAL OPPORTUNITIES:

As the population of the Brainerd Lakes Area grows, so too will demand for accessible recreational opportunities. This demand will become increasingly difficult to meet as more land is developed, thus shrinking the recreational resource base. Residents are worried that as the population grows, the amount of acres of public land available per person for recreation will decline, as is occurring statewide. Trail users are worried that major trail corridors like the Paul Bunyan Trail are being encroached upon by housing developments. In addition, due to changing market conditions for Potlatch Corporation, many private forestlands historically held by

Potlatch are now being converted to development and/or leased, thereby removing them from public recreational use. Recreational opportunities not only contribute to a high quality of life for residents, but they also contribute to the region's economic vitality through tourism. Plentiful parks, trails and open space for both passive and active recreation are just as important as our lakes in creating a unique sense of place for the entire Brainerd Lakes Area.

Recommendations for individuals to promote accessible recreational opportunities:

1. **Get involved with your lake association or neighborhood association.** Local development is often guided/inspired by grassroots groups with strong opinions about what sorts of recreational opportunities are needed in their particular neighborhood.
2. **Make phone calls, write letters and send emails to your elected and appointed officials.** Let them know how important it is to have easily accessible recreational opportunities in your community.
3. **Vote in decision-makers who understand the importance of recreational opportunities like parks and trails as ways to promote a healthy, active lifestyle for residents and visitors alike.** Studies continually show that a lack of recreational opportunities like safe biking and walking trails, is contributing to an unhealthy way of life for many Americans. Rates for obesity, diabetes and hypertension have significantly increased in recent years, and the reason is a significant decrease in the level of physical activity for the average American. Leaders looking to reshape their communities (and ultimately their citizens) should make it easier for people to walk and bicycle rather than drive.
4. **Attend and participate in civic meetings to discuss the recreational needs of your community.** Don't sit at home watching TV and assume that others will attend and voice your opinion. Even if they do, hearing it from 2 concerned people is a much more powerful motivator than hearing it from just one.
5. **Run for an elected public office or get appointed to your local Parks Advisory Committee.** Put yourself in a position to make decisions that can positively impact your community.

Recommendations for nonprofits to promote accessible recreational opportunities:

1. **Educate elected and appointed officials on Smart Growth, which promotes growth and development balanced with environmental conservation.** The planning of healthy, livable communities should be complete, integrated and contain an ample supply of pedestrian pathways, bike paths, town squares, greens and parks mixed in amongst housing, shops, work places, schools and civic facilities.
2. **Build coalitions amongst the various and sundry recreational user groups like bicyclists, canoeists, ATV enthusiasts, hikers, birdwatchers, snowmobilers, cross-country skiers, etc.** There is strength in numbers, and many recreational areas that serve one group can also be utilized in a non-confrontational manner by another.
3. **Help local officials to identify areas conducive to siting motorized recreation areas.** High intensity uses like ATV and dirt bike trails should be sited where they can serve the most citizens while having the least adverse impacts on sensitive environmental resources.

Recommendations for local units of government to promote accessible recreational opportunities:

1. **Create a Parks, Trails and Recreation Master Plan that maps out an interconnected network of easily accessible recreational opportunities for all citizens and visitors.** Counties should work closely with cities and townships to coordinate this network that is easily accessible to all ages and abilities. First, identify all current recreational resources, and second, determine where gaps exist and what areas are suitable for expansion. Counties and townships should also work closely with cities to have them define their outermost boundaries (due to future annexation) and create open space buffers (perhaps parks and trails) between municipalities.
2. **Create a Parks Dedication Ordinance as part of a recreation improvement and expansion fund.** Any new subdivision developments should be required to dedicate either 10% of the land or 10% of the fair market value of the land for the creation of additional parks and open space necessary to accommodate a growing population. Many communities have found Parks Dedication fees to be an excellent funding mechanism to improve, enhance and increase recreational opportunities.
3. **Create and enforce a Noise Ordinance.** High intensity recreational uses like ATV's dirt bikes, and mudder trucks are growing in popularity. Motorized recreational enthusiasts deserve places to recreate, but common sense dictates that they should be sited away from high-quality natural areas (such as prime wildlife habitat) and away from residential areas where the noise becomes an issue. Creating a noise ordinance will help limit citizen complaints, and it may force the manufacturers of ATV's and dirt bikes to develop better muffler systems.
4. **Through Comprehensive Plans and Zoning Ordinances, create communities that promote physical activity.** Studies continually show that a lack of recreational opportunities, like safe walking and biking trails, is contributing to an unhealthy way of life for many Americans. Rates for obesity, diabetes and hypertension have significantly increased in recent years, and the reason is a significant decrease in the level of physical activity for the average American. This is due, in large part, to automobile-oriented, sprawling communities that suppress biking and walking alternatives. We need more community parks, more regional parks, more public beaches, more public swimming pools, and safe ways to get to them by walking or bicycling (such as trails and sidewalks).
5. **Create easily accessible recreation areas in populated (urban) centers.** Forty-six percent of the population of Crow Wing County lives within seven miles of the Brainerd/Baxter area. Many of those living within the populated centers complain that there aren't enough green spaces with benches for passive "unplanned" recreation (like relaxation, casual bird watching, wildlife viewing, or simply reading a book) that are located within easy walking distance of their residence. There is a recognized lack of public lands for recreation (both passive and active), especially in heavily populated areas. One strategy might include the outright purchase of land in populated areas to create more neighborhood and community parks for urban recreational uses. Granted, there are still large tracts of undeveloped public land in the northern part of the county, but these parcels are largely managed for timber production and not recreation, and they are not "easily accessible" to the average user.

APPENDIX E: MAP NOTES

The following maps were generally created using free, publicly available data sources. All data sources are listed in the attached bibliography section. ESRIs ArcGIS 8.3 was used to create and analyze the maps.

City and township borders are as of 2000, and may not reflect the most recent changes.

Although these maps and data are intended to guide development, these maps should not be used for site-specific planning or development.

These maps shall not be modified without consent from the Brainerd Lakes Area Conservation Collaborative.